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ELECTRICIAN PUBLISHING COMPANY,

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INDEX.

Aerial Wires in New York, War on..... 183
Air Ship, De Bausset's..... 26
Akron, O., Sprague Road at..... 265
Alliance, O., Electric Road at..... 179
Alternate and Direct Currents, The Comparative Dangers of, by P. H. Vander Weyde, M. D., and Discussion (National Electric Light Association) 133, 134
Alternating *vs.* Direct Current Distribution, by H. Franklin Watts..... 98
Alternating Work of the Fort Wayne Jenney Company..... 182
American Electric Manufacturing Company..... 15
American Institute of Electrical Engineers' Proceedings..... 5, 7, 27, 28, 29, 40, 41, 42, 54, 55, 57, 209, 210, 222, 223, ... 269, 271, 272
American Street Railway Association, Report of Proceedings..... 2, 21
Ammeters and Voltmeters, Electrolytic..... 110
Ampere, Monument to. Illustrated..... 265
Ampere, Reminiscences of..... 233
Annunciator, A Cottage. Illustrated. (Standard Electrical Works)..... 206
Annunciator Drops on a Derived Circuit 111
Arc Lamp Hood. Illustrated. (The Western Electric Co.) 1
Arc Lamp, The Waterhouse. Illustrated..... 229
Auditorium Electric Plant..... 39, 52

Battery, Automatic Medical. Illustrated. (H. B. Cox Electric Co.)..... 155
Batteries, Galvanic, by C. H. Rudd. Illustrated..... 181
Battery, New Form of Law. Illustrated..... 182
Batteries, Polarization of, by Prof. H. S. Carhart. Illustrated..... 205
Baxter Motor Company..... 301
Bell, New Iron Box. Illustrated. (Western Electric Co.) 291
Bells, Musical Electric Illustrated. (Shaw & Geary), 205
Bell Hangers' Hand-Book, by F. B. Badt. Illustrated..... 194, 195, 206 207, 218, 219, 232, 233, 244, 245, 255, 256, 257, 267, ... 268, 280, 281
Bell, The Keating & Roxburgh Electric..... 218
Bell, Two-Call Indicating Illustrated. (Partrick & Carter) 158
Bell Victorious over Cushman..... 38
Belting, Perforated Leather. Illustrated. (Charles A. Schieren & Co.)..... 156
Bloomington Electric Light Plant, The..... 171
Board of Electrical Control, The New York... 43, 45, 46, 47, 57, 58, 59, 60, 73, 74, 75, 85, 86, 87, 98, ... 174, 224
Board of Electrical Control, High Tension System before the—
Harold P. Brown's Letter..... 43, 45
Communication from T. Carpenter Smith..... 45
Communication from S. C. Peck..... 45, 46
Communication from M. M. M. Slattery..... 46, 47
Communication from Ralph W. Pope..... 47
Communication from Prof. Henry Morton..... 47
Communication from O. B. Shallenberger..... 57, 58
Communication from H. M. Byllesby..... 58
Communication from William H. Browne..... 58, 59
Communication from Seymour G. Smith..... 59, 60
Affidavit of W. L. Wright..... 60
Harold P. Brown's Reply..... 73, 74, 75, 85, 86
Dr. Peterson's Paper..... 86
Experiments..... 86, 87
Board of Electrical Control, The New York, Rules and Regulations..... 98, 99
Board of Electrical Control, Suggestions for, by E. A. 52
Book Table Talk..... 17, 26, 107, 295, 206, 253, 293, 305, 329
Boston, Sprague Road at. Illustrated..... 331, 332
Brush Electric Co. 135, 186, 269, 281
Burglar Detector, Model. Illustrated..... 241
Burglar Proof Lights..... 301
Burglar and Fire Alarm. Illustrated. (Keating & Wright)..... 277
Burning the Eyes..... 104
Business Mention..... 12, 24, 36, 50, 64, 89, 90, 101, 114, 164, 177, 178, 189, 190, 202, 214, 228, 239, 240, 252, 263, 264, 275, 288, ... 300, 311, 324, 336

Cable Laying, Early History of 158
Call and Integraph, The Abdank Magnetic, by B. Abdank Abakanowicz. Illustrated (American Institute of Electrical Engineers)..... 269
Cable Operators..... 303
Cables, Suakim Electric Lights and the African 303
Cell, Carbon-Containing. Illustrated. (E. S. Hotchkiss)..... 218
Chicago Arc Light & Power Company, Fire in the Station of the..... 155
Chicago City Electric Lights 51, 265, 289, 313
Chicago Edison Station, The. Illustrated..... 103, 104
Chicago Electric Club..... 52, 65, 180, 235, 236, 237, 314
Chicago Electric Light Franchises..... 15, 16
Chicago Exposition Electric Light Plant. Illustrated. (Western Electric Co.)..... 110
Chicago Opera House, Electric Light in the..... 13
Chicago Telephone Building, The. Illustrated..... 105, 106, 107
Chicago Telephone Controversy..97, 156, 174, 290, 291, 313
Chicago West Side Surface Roads..... 315
Cincinnati Electrical Society, Report of Proceedings..... 210, 211, 212, 213
Cincinnati Exposition, Incandescent Lamps at..... 65
Cincinnati Exposition, The. Illustrated..... 215, 216, 217
Cincinnati, Sprague Road at..... 307
Circuit Closing Key, Automatic (South Bend Automatic Key Closer Co.) Illustrated..... 26
Clark, Oscar G., Death of, by an Electric Shock..197, 198
Cleveland Electric Road..... 53
Composite Balance, Sir Wm. Thomson's, by Thomas Gray, B. Sc. Illustrated..... 14, 15
Conductor, Earth for a Lightning..... 156
Conductors in Europe and America, Underground Electrical, by Prof G. W. Plympton and Discussion. (American Institute of Electrical Engineers)..... 5, 7
Conduit for Electric Wires, Irish's. Illustrated.. 38, 39
Converters in America, by Prof. Forbes, (London Society of Telegraph Engineers and Electricians)..... 1
Copper Trust, The 305
Corliss Engine, The Sioux City (Sioux City Foundry & Machine Works). Illustrated..... 248
Correspondence, 9, 10, 11, 20, 21, 33, 34, 48, 49, 60, 61, 62, 75, 76, 87, 88, 99, 100, 111, 112, 113, 161, 162, 163, 174, 175, 176, 186, 187, 198, 199, 200, 213, 224, 225, 226, 237, 238, 249, 250, 261, 262, 272, 273, 274, 284, 285, 286, 296, 297, 298, ... 308, 309, 310, 321, 322, 333, 334
Court of Patent Appeals 183
Cushman Telephone Company..... 104
Cutting Lamps in or out of Circuit, Device for. Illustrated 2

Davenport Electric Railway 82, 107
Dayton Electric Railway, The 97
Dental Electrics..... 156, 157
De Bausset's Air Ship 26
Des Moines Electric Road, The 79
Detroit Storage Battery..... 325, 326, 327, 328
Disruptive Discharges and their Relation to Underground Cables, by E. G. Acheson. Illustrated. (National Electric Light Association)... 124, 125, 126
Distribution, Alternating *vs.* Direct Current. H. Franklin Watts 98
Door Opener, Electric (Empire City Electric Co.) Illustrated 315
Double Induction Motor, The Sperry (Electrical Supply Co.) Illustrated 65
Dynamo, A New Eighteen-Light. Illustrated. (C. E. Jones & Bro.). 203, 204
Dynamo, How to Build an Eighteen-Light. Illustrated. (C. E. Jones & Bro.) 241, 242, 243, 244
Dynamo, The Silvey. Illustrated..... 179
Dynamo, The Ferranti. Illustrated..... 279, 280

Edison Companies, Convention of..... 79
Edison Company, New Capital for the 293
Edison's Laboratory, Electricians at..... 231
Edison Station, The Chicago. Illustrated 103, 104
Edison Incandescent Lamp Patent in England ..332, 333
Editorial Notes, 6, 18, 30, 44, 56, 72, 84, 96, 108, 128, 148, 160, 172, 184, 196, 208, 220, 234, 246, 258, ... 270, 282, 294, 306, 318, 330
Education, Electrical, by Edwin Ruthven Weeks, and Discussion (National Electric Light Association) 135, 136, 137
Electric Light, The (Notes), 11, 22, 34, 49, 63, 76, 88, 100, 113, 163, 176, 177, 187, 188, 200, 201, 213, 226, 227, 238, 250, 251, 262, 274, 286, 287, ... 298, 310, 322, 323. 335
Electric Light Convention Echoes..... 154
Electric Lights at Suakim and the African Cables. Illustrated..... 303
Electric Lights in the Lumber Business..... 182
Electric Light & Gas Company of Woodland, Cal., Plant of the. Illustrated 91
Electric Light *vs.* Gas 159
Electric Lights in Baker's Theater 265
Electric Light in the Chicago Opera House 13
Electric Light and Danger from Fire, The..... 329
Electric Messenger, Porter. Illustrated. (New Haven Clock Co.)..... 231
Electric Postal Road at Baltimore, The New 183
Electrical Measurement, Some Methods of, by G. A. Liebig, jr., and Discussion (National Electric Light Association) 134, 135
Electrical Railway System, Thomson-Houston. Illustrated 37
Electricity, What is? 244
Electricity as an Employment, by F. B. Crocker..... 198
Electrolytes, Method for Measuring the Resistance of, Johann Carl Parthner. Illustrated..... 291
Elevated Suspension Railway, Forsyth's. Illustrated. 53
Engine Diagrams, Electric Light 111
Engine of War, New..... 158
Executions, Electric..... 319
Express, Weems' Electric, Illustrated 83

Ferranti Dynamos, Grosvenor Gallery. Illustrated. 279, 280
Filling Materials in the Mouth, Dissimilar Metals used as; Dr. George W. Whitefield (Chicago Electric Club) Illustrated. 315, 316, 317
Fire Alarm Signal Box (United States Electric Fire Alarm Co.) Illustrated 26
Flour Mill, The First Electric 82
Floor Key and Button, Combination. Illustrated. (Central Electric Co.) 229
Focusing Lamp, A New (Western Electric Co.) Illustrated..... 13
Fort Wayne Jenney Company 301
Fort Wayne Jenney Works Destroyed by Fire 277
Fort Wayne Jenney Company, Alternating Work of. 182
Fuel Oil Experiments in Chicago..... 313

Galvanometer, A Swinging Arm, by George S. Moler, A. B. M. E. Discussion. (American Institute of Electrical Engineers)..... 7
Galvanoscope, Firman Pocket (Western Electric Co.) Illustrated 79
German Electrical Field, The 179
Ground Switch, An Automatic (Electrical Supply Co.) Illustrated..... 15
Gravity Drop Annunciator (Central Electrical Co.) Illustrated..... 73
Great Western Telegraph Company, The Defunct... 159

Hannahs Road in Chicago, The Proposed..... 315
Heat from Electricity..... 39
Heisler Station, Leavenworth. Illustrated..... 314
Heisler System at Wabash, Ind., The. Illustrated.. 3
High Tension System, Edison's. Illustrated..... 229, 230
Hood, Arc Lamp (Western Electric Co.) Illustrated. 1
Hotel del Coronado, Mather Plant in. Illustrated... 51
Housework Novelties, Electrical. Illustrated. (Novelty Electric Co.)..... 191

Incandescent Lamp Breakage, A Guard Against. Illustrated.... 295, 296
Incandescent Lamps in the Columbia Theater....167, 168
Incandescent Lights, The Grand Opera House..... 154
Incandescent Lamps for Street Lighting..... 302
Installation Projected at Marquette, Mich., A Novel. 198
Interferences with Telephone Systems and Means of Relief, Dynamo Current, by C. E. McCluer, and Discussion (National Telephone Exchange Association) 145, 146, 147

Julien Company, The..... 249

Lamp Lighting Schedule.....62, 111, 187, 224, 296
Launch, Viscountess Bury, The Electric.....248, 249
Launch, The Electric..... 2
Lifting Power of Magnets, by Prof. John E. Davies.. 109
Lightning's Freaks..... 158
Lightning Notes..... 180
Light and Power Plant at Thorenberg. Illustrated.. 290
Lighthouse, Chicago Electric. Illustrated 255

Magnetism in Watches, by C. K. Giles. Illustrated 93, 94, 95
Magneto Call, with Manual Telephone Switch (Keating & Roxburgh). Illustrated..... 307
Magnetos, by F. B. Badt..... 295
Magnets, Lifting Power of, by Prof. John E. Davies. 109
Manganese Steel, Non-Magnetic Properties of...109, 110
Marquette, Mich , A Novel Installation Projected at.. 198
Mather Plant in the Hotel del Coronado. Illustrated. 51
Matrix Making Machine, Electrical. Illustrated ..92, 93
Melbourne, The Electric Light in..... 95
Metals Used as Filling Materials in the Mouth, Dissimilar. Dr. George W. Whitefield. (Chicago Electric Club.) Illustrated.....315, 316, 317
Meter for Direct and Alternating Currents, The Geyer-Bristol, by Prof. William E. Geyer. Illustrated. 266, 267
Meterage System, A New, by W. Lowrie. Illustrated 191, 192, 193
Miscellaneous Notes, 23, 35, 50, 64, 77, 89, 101, 189, 201 202, 228, 239, 251, 252, 263, 275, 299, 300, 311, 323 324, 336.
Motor, Alternating Current, Trial of the..... 305
Motor for Horse Cleaning. Illustrated..... 52
Motor for Pumping Organ..... 254
Motor in the Sick Room, The Electric 83
Motors, Note on Gearing for Electric Railway by Almon Robinson. (American Institute of Electrical Engineers) 209, 210
Motor, The New Thone Electric. Illustrated. (Hawkeye Electric Manufacturing Company)..... 289
Motor Installation, Interesting.....283, 284
Motor Power Wanted 302
Motor Service in New York..... 314
Motors in England..... 25
Motor Service, A Basis from which to Calculate Charges for Electric, by H. F. Lufkio, and Discussion. (National Electric Light Association.) 137, 138, 139, 140
Motor, The Card Constant Current. Illustrated. (Geo. F. Card Manufacturing Co.)..... 230, 231
Motor, The Electric (Notes) 11, 22, 35, 49, 63, 77, 88, 101 113, 164, 177, 188, 201, 214, 227, 238, 239, 251, 262 263, 274, 287, 298, 299, 310, 311, 323, 335
Motor, The Future..... 265
Motor, The Belding. Illustrated. (Belding Motor and Manufacturing Co.)..... 302
Motor, The Grove Electric. Illustrated. (Grove Electric Co.)..... 283
Motor, Thomas Electric. Illustrated. (Knapp Electrical Works)..... 301
Magnetic Call and Integraph, The Abdank, by B. Abdank Abakanowicz. Illustrated. (American Institute of Electrical Engineers)..... 269

National Electric Light Association..... 268
National Electric Light Association, Constitution of the..... 156
National Electric Light Association, Report of Proceedings.....115–142
National Telephone Exchange Association, Report of Proceedings 143–154
New York Electric Club..... 284
New England Electric Exchange, The.....85, 157, 207
Balances, Paillard's Non-Magnetic. Illustrated..... 157

Okonite Conductors..... 48
Old Time Telegraphers.....91, 92
Ores, Reduction of Refractory. Illustrated..... 168
Overhead Conductors for Electric Railways, Some Objections to the, by M. B. Leonard. (American Institute of Electrical Engineers)..... 209
Overhead and Underground Wires in New York, by Dr. Schuyler S. Wheeler, and Discussion. Illustrated. (National Electric Light Association).. .....122, 123, 124, 127, 129, 130, 131, 132, 137

Patents, Electrical, Issued in the United States..... 12, 24, 36, 50, 64, 77, 78, 90, 102, 114, 164, 165, 166 178, 190, 202, 214, 228, 240, 252, 264, 275, 276, 288 300, 311, 312, 324, 336.
Pentane Lamp, Test of, by W. Stepney Rawson..307, 308
Petroleum Fuel, by S. S Leonard, and Discussion. (National Electric Light Association)...119, 120, 121
Petroleum Fuel, by S. S. Leonard..... 183
Phonograph and Graphophone Controlled by one Company..... 39
Phonograph Company, Chicago..... 277
Phonograph, Edison's in London..... 1, 2
Phonographic Facts..... 183
Photography, Aerial..... 17
Polarization of Batteries, by Prof. H S. Carhart. Illustrated..... 205
Porter Electric Messenger Illustrated. (New Haven Clock Co.) 231
Potter Palmer's Residence, Chicago Installation in.... 332
Practical Talks by Practical Men:
Address by Dr. Schuyler S. Wheeler..... 198
Electricity as an Employment, by Francis B. Crocker..... 198
Protection and Electric Lighting..... 290
Pullman Electric Road..... 180
Pulsatory Current System, A. Illustrated..... 180
Push and Clamp, Extension Foot. Illustrated. (Partrick & Carter)..... 254
Push Buttons, New Styles of. Illustrated. (Redding Electric Co)..... 260

Railway Telegraphers, Order of..... 26
Railroad Telegraphers' Convention..... 2, 3
Railway Telegraph Superintendents.....32, 33
Rapid Transit, Solution of Municipal, by Frank J. Sprague, and Discussion (American Institute of Electrical Engineers) Illustrated..... .....27, 28, ... 29, 40, 41, 42, 54, 55, 57, 209, 210, 222, 223
Rapid Transit Companies, Charters for.....13, 14
Reflector Shade. Illustrated. A. A. McCreany..... 168
Regulations, Copenhagen Electric Light..... 207
Regulator, The Curtis Pressure. Illustrated. (Curtis Regulator Company)..... 284
Regulator, The Waterhouse Automatic. Illustrated.. 167
Richmond Electric Road, The 20

Sea Coast Defences, Electricity as applied to....223, 224
Shocks, Deadly and Otherwise..... 105
Shock, Moral effect of..... 284
Sibley, Hiram, Death of. With Portrait..... 25
Silvey Alternating Current Street Car System, The Illustrated..... 266
Sounder, Irish's Marine Illustrated..... 80
Speed Indicator, Heath's Self-Timing. Illustrated. (Eddy Electric Manufacturing Company)..... 52
Speed Recorder, An Electric, by George H. Barrus, (American Society of Mechanical Engineers)..19, 20
Sperry Double Induction Motor, The. (Electrical Supply Company). Illustrated..... 65
Sperry Electric Company..... 52
Static Electricity in Dynamos. F. B. Badt. Illustrated. (Western Electric Company.)..... 302
St. Catherine's Electric Light..... 81
Stetho Telephone Company, The Lowth..... 104
Street Car System, The Silvey Alternating Current. Illustrated 266
Subways, The New York, by Leonard F. Beckwith, and Discussion (National Telephone Exchange Association) 151, 152
Switch Lights, Electric 26
Switch, New Dynamic Incandescent. Illustrated. (Hartford Dynamic Co)..... 156
Storage Battery and its Applications. Paget. Illustrated..... .....291, 292, 293
Storage, Electric, by Philip Atkinson, Ph. D. Illustrated. Concluded.
Faure Secondary Cell..... 3
Chemical Reaction in the Faure Cell.....3, 4
Faults of the Faure Cell..... 4
The Improved Faure Secondary Cell..... 4
Fluid, The 4
Electric Formation of the Plates. 4
Electromotive Force, Resistance and Current of Cell..... 4
Weight of Cell and Thickness of Plates. 4
Cause of Buckling.....4, 5
Variable Resistance of the Electrolyte..... 5
Inspection..... 5
Formation of the Battery..... 5
The Julien Accumulator..... 5
Storage Battery, The Detroit. Illustrated....325, ...326, 327, 328
St Louis Telephone Company Victorious over the Municipal Assembly.....326, 327
Suakim, Electric Lights at, and the African Cables. Illustrated 303

Telautograph Company, Gray's National..... 79
Telautograph, Gray's. Illustrated..... 66, ... 67, 68, 69, 70, 71, 73
Telegraph Bill, Inter-State..... 157
Telegraph, The (Notes).....23, 35, 50, 63, 64, 77, 88, 89, 101, 114, 164, 177, 189, 201, 214, 227, 228, 239, 251, 263, 274, 275, 287, 299, 311, 323, 336
Telegraph, The Writing. by W. E. Gump. Illustrated.....169, 170, 171
Telegraphers, Old Time..... 91, 92
Telegraph Operators in Asia..... 19
Telegraphers in Texas, Girl 97, 98
Telegraphy, Machine..... 98
Telegraphers' Trials 53
Telegraphy, Pioneer..... 301
Telegraphy, The Babyhood of, by James D. Reid,
Bernard O'Connor and Prof. Morse..... 159, 173
Alfred Vail..... 173
Gen. Anson Stager..... 173, 174
Morse's Fight with Poverty..... 174
Telephone, The. By Dr. S. M. Plush and Discussion (National Telephone Exchange Association) 152. 153
Telephone and Electric Light and Power Circuits and Railways, The Electrical Relation of, by Thomas D. Lockwood, and Discussion. (National Telephone Exchange Association).....147, 149, 150 151
Telephone Batteries, Notes on, by F. A. Pickernell and Discussion. (National Telephone Exchange Association).....143, 144, 145
Telephone, The McDonough..... 110
Telephone, Slander by..... 203
Telephone, The (Notes).....11, 12, 22, 23, 35, 50, 63, 77, 101, 113. 114, 164, 177, 188, 189, 201, 227, 239, 251, 263, 274, 287, 299, 311, 323, 335
Telephone Exchange, Largest..... 65, 82
Telephone Exchanges of New York City, The, by E. F. Sherwood, and Discussion (National Telephone Exchange Association)..... 152
Telephone Exchange System, New. Illustrated..... 207
Telephone Lines and Heavy Electric Currents..... 182
Telephone in the West, The Long Distance..... 159
Telephones in Sweden, by Thomas D. Lockwood.... 52
Telephone, Prof. Dolbear and the..... 73
Telephone Systems and Means of Relief, Dynamo Current Interferences with, by C. E. McCluer, and Discussion (National Telephone Exchange Association)..... .....145, 146, 147
Telephone Switch, Magneto Call, with Manual. Illustrated. (Keating & Roxburgh.)..... 307
Telephone Company Victorious over the Municipal Assembly, St. Louis.....326, 327, 328
Telephone, The Krebs,..... 207
Telephone Legal Case 159
Telephooy, Practical, by Thomas D. Lockwood, Illustrated, Continued.....
Remedying Faults 8
Flexible Cords..... 8
Advice to Subscribers..... 31
Long Distance Telephony,..... .....231, 232, 259, 260, 304, 305
Thomson's, Sir William, Composite Electric Balance, by Thomas Gray, B. Sc. Illustrated 14, 15
Thomson–Houston Boston Offices 224
Thomsoo–Houston Electrical Railway System. Illustrated... 37
Thomson–Houston Lynn Factory 193, 194
Thomson–Houston System at the Italian Exhibition. Illustrated..... 313
Time System, Warner Electric. Illustrated. (New Haven Clock Compoy.)..... .....253, 254
Torpedo Service, The. 204, 205
Topeka Electrical Road 203
Torch, An Automatic. Illustrated. (Electrical Supply Co.)..... 183
Tramway Association, Ohio State 284
Type Justifying Machine..... 207

Underground Arc Light Circuits, Successful, by B. E Sunny..... 9
Underground Conduit, Description of, by Alex. Crawford Chenoweth and Discussion, Illustrated. (National Electric Light Association)..... 126

24143
24144

Underground Electrical Conductors in Europe and America, by Prof. G. W. Plympton, and Discussion. (American Institute of Electrical Engineers) 5, 7
Underground Work in Brooklyn, by W. D Sargent. National Telephone Exchange Association..... 151
Unprotected Watch, The 105

Vacuum as a Non-conductor and its Bearing on Electrical Theories, by Dr. P. H. Vander Weyde. Illustrated..... 320, 321
Van Depoele Incandescent System, Illustrated... 328, 329
Van Rysselberghe System at Brussels, The..... 157
Vestibuled Electric Cars 51
Vibrations, The Universality of, by C C Haskins (Chicago Electric Club) 235 236, 237

Wabash, Ind., The Heisler System at 3
Watchman's Clock and Fire Alarm Indicator Illustrated. (Central Electric Company).. 283
Welding, Electric, by Otis F. Stuart (Association of Railway Telegraph Superintendents) 33
Welding, Electric..... 219
Welding Machine, Direct Electric Illustrated.... 16, 17
West Side Cable Road, Opposed to 325
Western Electric Company's New Factory in New York..... 20
Westinghouse Acquires the Waterhouse..... 254
Westinghouse against Fort Wayne Jenney..... 81
Westinghouse Leases the Consolidated and Sawyer-Man Companies..... 204
Wire, Combination in 277
Williams' Engine at Edgewater Station. Illustrated 278
Wires in Washington. 99
Woodland, Cal , Plant of the Electric Light and Gas Company of. Illustrated..... 91

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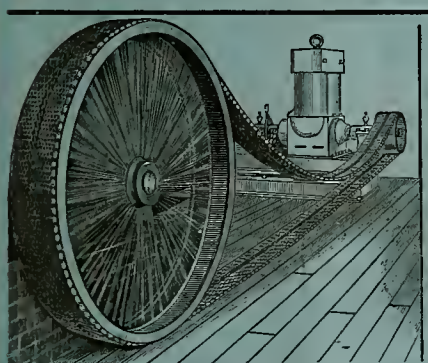

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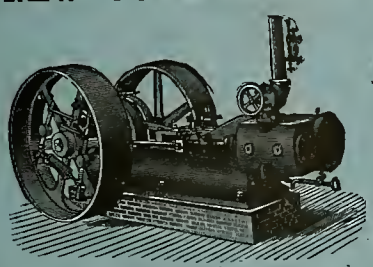

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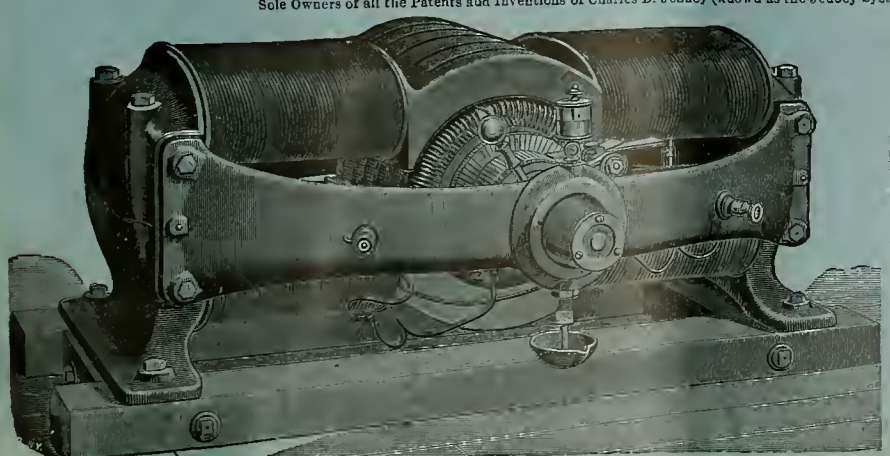

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The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St.

INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

EASTERN OFFICE:
178 DEVONSHIRE STREET, BOSTON.

WESTERN OFFICE:
148 MICHIGAN AVE., CHICAGO, ILL.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.

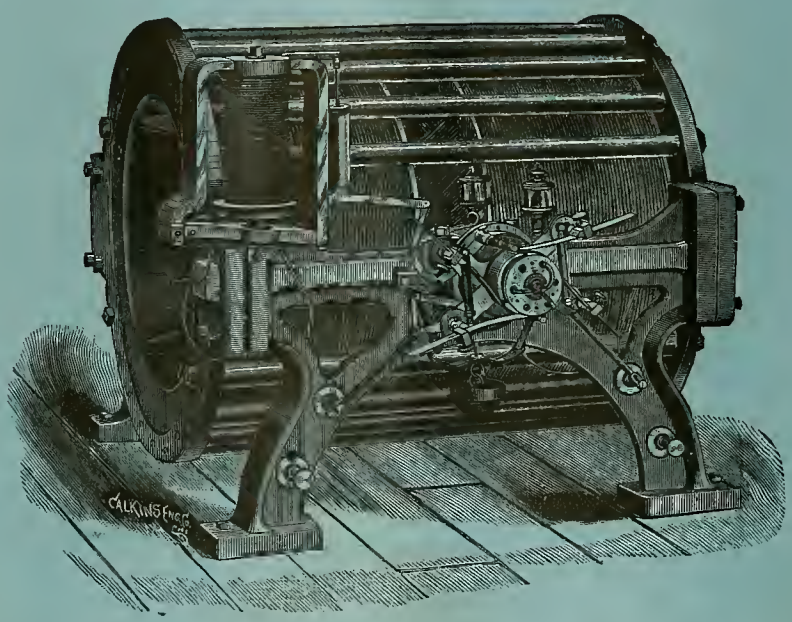
SERIES LAMPS

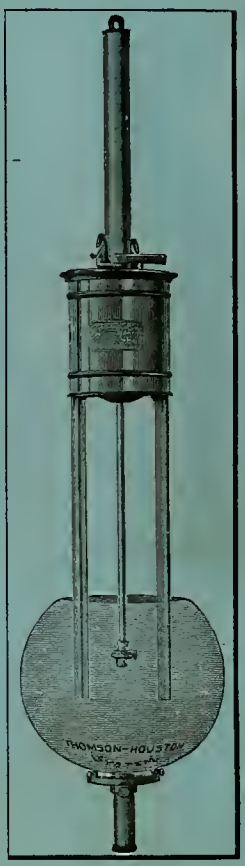
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



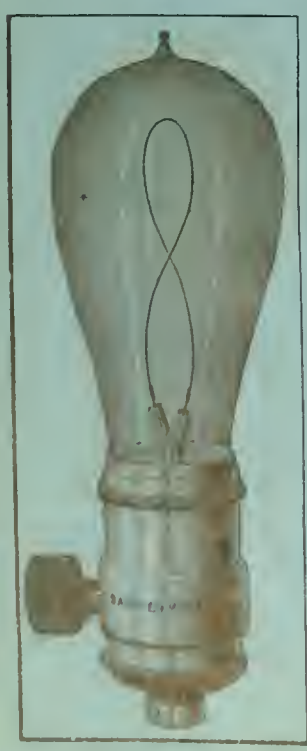


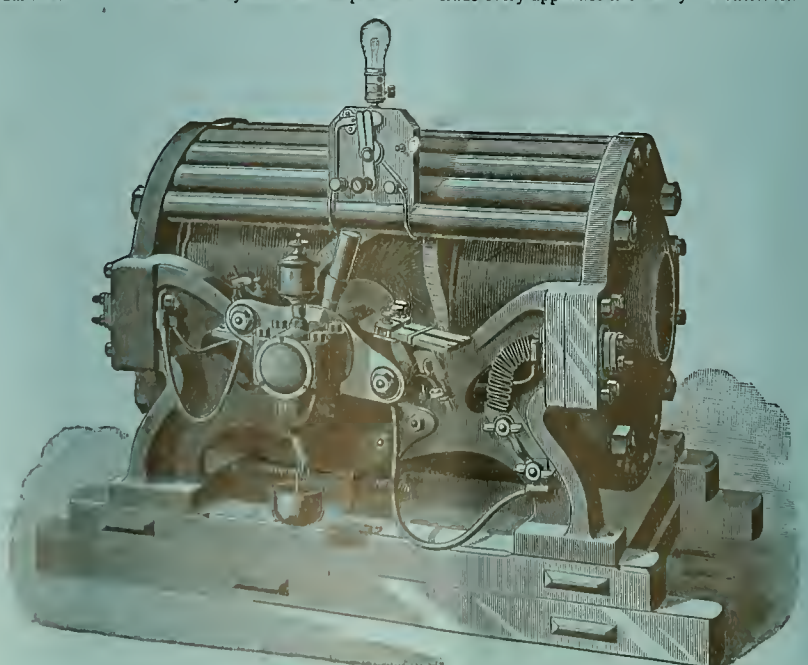
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

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NEW HAVEN CLOCK COMPANY,

MANUFACTURERS OF ALL STYLES ELECTRICAL GOODS.

315–321 WABASH AVENUE,

G. A. HARMOUNT, Agent. CHICAGO, ILLINOIS.

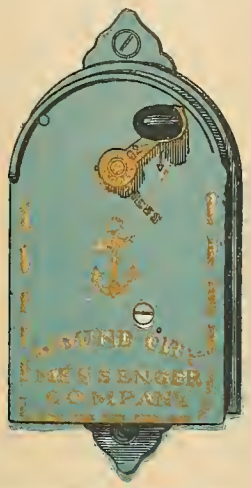
FACTORY: NEW HAVEN, CONN.

No. 5, or Fire Alarm Box.

No. 7—Same as No. 2, only Different Stenciling.

No. 1, or Vansize Return Signal Box.

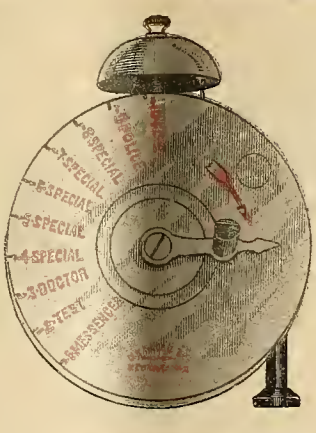
No. 12—Same as No. 2, Showing Different Stenciling.



No. 2—Western Union or American District Call Box. 1 or 4 Calls.

No. 10, or Seven-Call Box.

No. 4, or Ten-Call Box, with Return Signal.



The advantages of this box are as follows:

1st—Simplicity; no extra circuits or ground wire required.

2d—It is non-interfering, the return signal operating only on the box sending in the call at the time.

3d—The pointer may be set on the words Police or Fire before retiring, and in case it should be necessary to call during the night, it can be done by merely pushing up the button.

This releases and cuts in the movement and the call goes into the office. To release the box without sending in the signal, turn the button to the right without pushing it up, and the pointer will return to Zero.

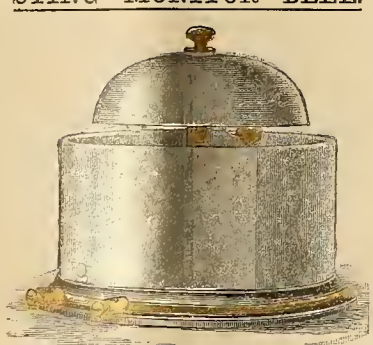
The Return Signal of this Ten-Call Box is simplicity in itself. The office, after receiving a call, cuts in a signal box in the same circuit as the box which called, by means of a spring cut out and plug, and the signal (which is understood by the subscribers as the return signal) is transmitted over the same wires to the subscriber, notifying him that his call has been received. The magnets of this box are cut in only when the subscriber sends in a call.

No. 11—One or Four-Call Box.

THE
UNIQUE WOOD BOX BELL.

STING MONITOR BELL.

WE CARRY IN STOCK A FULL LINE OF SINGLE STROKE AND WOOD BOX BELLS.



ALSO IRON FRAME OR SKELETON BELLS WITH STRUCK or CAST GONGS.

Patented May 13, 1887. Cut full size.

Send for Sample of Our Outside Street Fire Alarm Box.

THE SWALLOW BELL.

We manufacture in addition to the above District Call Boxes a full line of supplies for District Telegraph Companies—Registers, Single Stroke Bells, Ticket Cases, Automatic Tape Winders, Porcelain Insulators, Cleats, Pony Relays—and will furnish estimates on all accessories, including Stationery, Boys' Caps and Suits, etc., etc.

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ADDRESS G. A. HARMOUNT, WESTERN AGENT,

315 to 321 WABASH AVENUE, CHICAGO.

WE CARRY IN OUR STOCK ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.
LOWEST PRICES. PROMPT SHIPMENT GUARANTEED.

BOSTON. NEW YORK. SAN FRANCISCO. LONDON. LIVERPOOL KOBE & YOKOHAMA, JAPAN. SHANGHAI, CHINA.

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ALL STYLES ELECTRICAL GOODS.

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G. A. HARMOUNT, Agent. CHICAGO, ILLINOIS.

FACTORY: NEW HAVEN, CONN.

We make a specialty of TELEGRAPH INSTRUMENTS, always carrying in stock a full line of Morse Instruments, same pattern as now used by the Western Union Telegraph Co. We call attention to

THE UNIQUE KEY and THE UNIQUE SOUNDER,

equal in every respect to the Morse Instruments—but cheaper. Send for samples and prices.

SEND FOR ILLUSTRATED CATALOGUE AND PRICE LIST.

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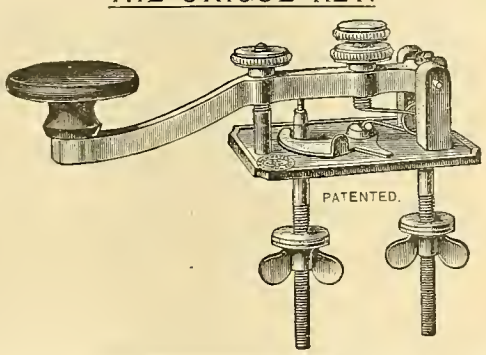
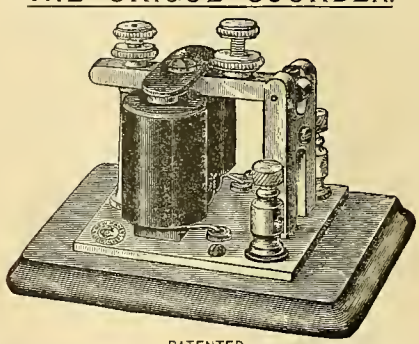


THE UNIQUE SOUNDER.



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LE CLANCHÉ DISQUE BATTERY.

We have thousands in use and they are giving perfect satisfaction. Send for samples.

POROUS CUPS COMPLETE, 35c.

We are agents for the Improved Porous Cup Batteries.

OUR NEW COMBINED ANNUNCIATOR AND BELL.

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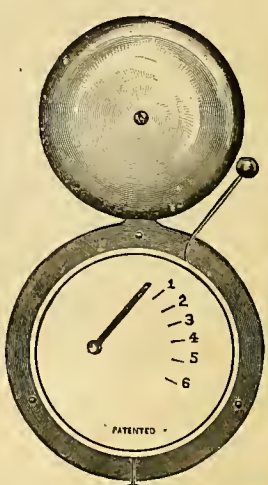
Send for samples.



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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

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As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

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610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

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EDISON VS. THE UNITED STATES ELECTRIC LIGHTING CO.

"WHOM THE GODS WOULD DESTROY,
THEY FIRST MAKE MAD."

The anger of the Edison Company, since being beaten at law, is forcibly manifested by a "Confidential Circular to Edison Agents" over the signature of E. H. Johnson, President of the Edison Electric Light Company, New York, containing alleged explanations as to why Edison was beaten at law, in which the dignified (!) president delivers himself of his wrath in a tirade of abuse, libelous and personal, against a most humble and unimportant individual, and produces the first "patch" for the "collapsed airship" as predicted in "The Edison Boomerang" Circular.

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Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

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NEW YORK

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No. 308 WALNUT ST

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

RICHMOND ROAD

SPRAGUE SYSTEM.

Total Trackage, 12 Miles. Maxmum Grade, 10 1-10 per cent.

Twenty-nine curves, each as a 27-foot radius with 5 per cent. grade, 40-foot radius with 8 1-2 per cent. grade, etc.
Total Equipment, 40 Cars. Full size, 16-foot closed and 22 foot open cars. 30 Cars Now in Operation.

COST OF OPERATING SIXTY PER CENT. LESS THAN WITH HORSES.

The present mileage of 1,500 to 1,800 miles on these grades would require not less than 225 to 250 horses.
The entire operating expenses chargeable at the Central Station for thirty cars, with the present mileage, on the heaviest section of the track, is 1½ cents per car mile. This includes electrician, engineers, firemen, dynamo men, all coal, oil, waste, water, lighting and depreciation; the working force being, with the exception of one man, sufficient to handle forty cars. When the forty cars are in operation the expense will be reduced to about 1¼ cents per car mile run.
Number of Miles Run, 136,214. Passengers carried, 598,613. Schedule running time, 7½ miles per hour.

Total Operating Expenses, including everything, for the month of May, was only 47 per cent. of the Receipts.

Send for Map and Details of this Road.

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We hereby notify the trade, and all parties manufacturing, using, or selling Insulated Wires, that by virtue of United States letters patent Nos. 306,744 and 308,890 respectively, we own the exclusive right to manufacture and sell

THE GRIMSHAW "WHITE CORE" INSULATED WIRES AND CABLES,

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

which patents cover broadly, not only the *White Core Insulation*, but also method of manufacturing and the machinery used in connection therewith, thereby giving us ample protection for our goods. Under advice of the Counsel of this Company, we desire to give *formal notice* that all infringements of the above patents, or any of them, by the manufacture, use and sale of *"White Core" Insulated Wires and Cables* will be promptly and vigorously prosecuted, and those who have used or sold Wires and Cables infringing our patents will be made to account to us for damages.

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MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

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SOLE PROPRIETORS OF THE

PATENT NEEDLE-ANNUNCIATORS AND BURGLAR ALARMS.

WE MAKE A SPECIALTY OF

ELLS, DISQUE LECLANCHE BATTERIES, GAS-LIGHTING APPARATUS

AND A FULL LINE OF

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We publish Catalogues of all our Manufactures, and will forward to any address upon application.

N. B.—When applying for Catalogues, please state whether "Electric Bell" or "General" Catalogue is wanted, and if in the trade inclose business card for discounts.

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Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

HENRY A. REED, Manager.

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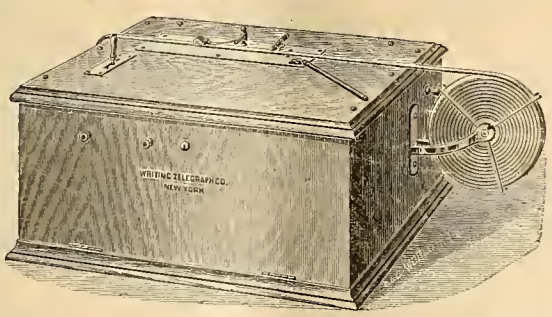
This Company owns the Letters Patent which thoroughly control the transmission of written messages by telegraph in the only known practical way, and are prepared to establish Central Office Exchanges as a means of communication between subscribers in cities and surrounding towns.

Communications are written with pen and ink in the handwriting of the person writing the message.



The pen in the office of the subscriber receiving a message makes a fac-simile of every letter as fast as it is made with the pen in the office of the person writing it.

All instruments are under the control of the Central Office, and messages are recorded on the instrument of a subscriber, whether he is present or absent.

All communications are secret, and the written record is of great value in commercial use.

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THE LAW TELEPHONE COMPANY

Begs leave to announce that it has largely increased the quantity and surface and greatly improved the form of the negative element of the

LAW BATTERY.

The New Form is clearly shown in the cuts and needs no explanation.

ITS ADVANTAGES.

The Battery holds up longer when overworked, recovers quicker when relieved, and the material being all in one piece instead of in two pieces, the breakage heretofore suffered in transportation, in handling, and in any depolarizing treatment (after accidental short circuiting) will be wholly saved. *"It was good before; it is better now."* The Battery *otherwise* is unchanged. The negative element is of the same material and undergoes the same preparation as before, and is *everlasting*, and so guaranteed.

THE OTHER FEATURES OF SUPERIORITY, NAMELY:

Connections that will not corrode, Lock-tops that absolutely prevent evaporation and creeping of salts, absence of grease, Flint Glass well annealed, Hard Rubber Bolt connection that is reliable and durable, pure Zinc and pure Sal Ammoniac, etc,

ARE ALL PRESERVED.

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THE

RAILWAY TELEGRAPH SUPPLY CO.,

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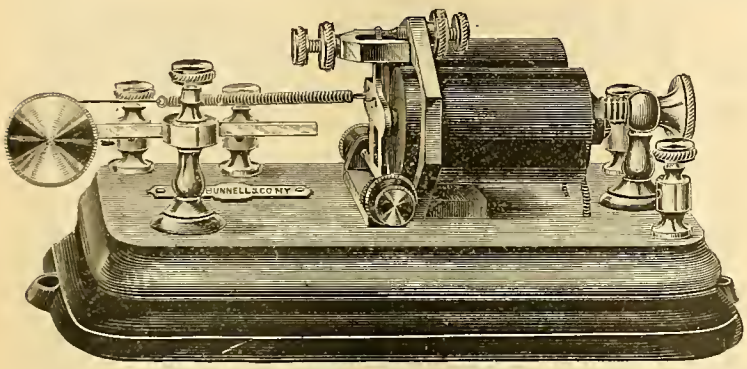
Manufacture and carry the largest stock of

MAGNETO BELLS, EXTENSION BELLS, ELECTRIC BELLS, ANNUNCIATORS, BURGLAR ALARMS, BATTERIES, AND SUPPLIES IN THE WEST.



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White Core Wires, Fire Proof and B. D. Wires for Telegraph, Telephone, Electric Light, Ærial, Underground and Sub-Marine.

THESE GOODS HAVE STOOD THE TEST FOR YEARS.

WRITE FOR PRICES.

WE MAKE AND HAVE FOR SALE THE

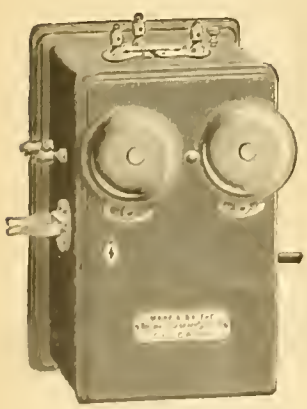
BEST

Vibrating and Single Stroke Bells

IN THE MARKET.

Wood and Iron Box, - - 2 to 5 inch.

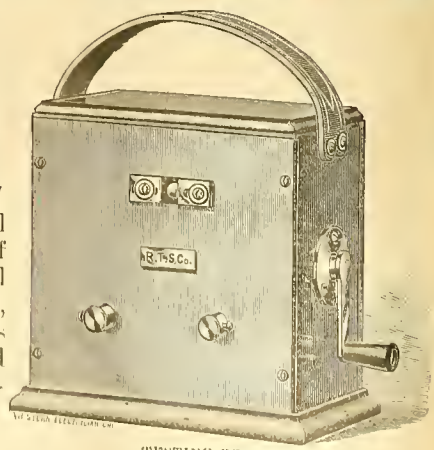
Skeleton form Bells, from 2 inch to 16 inch Gongs



WE FURNISH MAGNETO BELLS WITH OR WITHOUT TELEPHONE SWITCH.

SPECIAL MAGNETO BELL.

The accompanying cut shows a special magneto bell made by us. It has been designed especially for the use of electric light, telegraph and telephone companies, and for all wishing to test circuits of any kind. It is of high efficiency, and is capable of ringing through large resistance. It is small and compact, as the cut indicates. It is so arranged with switches that it can be used on alternating or continuous current, and in connection with a galvanometer.



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Pins, Cross Arms, Pole Steps, Tools, and all Kinds of Line Equipment.

All Goods Warranted First-Class. | Address all Communications to | All Goods Warranted First-Class.

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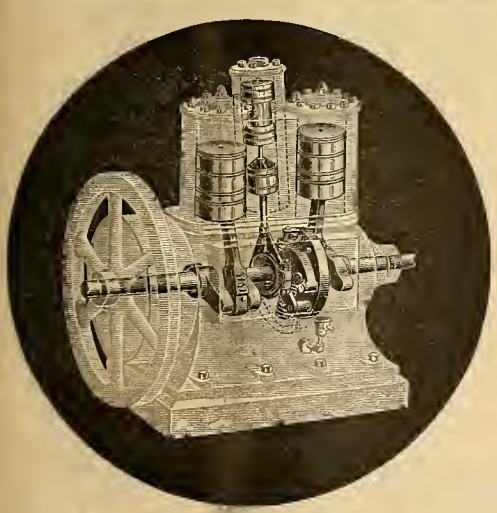

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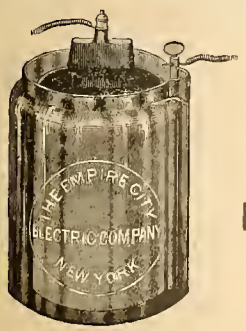

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EVERY SATURDAY,

Vol. III. CHICAGO, JULY 7, 1888. No. 1.

Arc Lamp Hood.

In an article descriptive of the Chicago river lighting plant, installed by the Western Electic company, pages 182 and 183, No. 15, Vol. II, mention was made of the new style of arc lamps used. The cut in connection illustrates the lamp and its weather-proof hood. This hood is made of heavy galvanized iron, japanned. The hood is supported by iron pipes which are fitted into a cast iron base, making the whole very strong and durable. The lamp itself is hung from a suspending board which is fitted with a hand switch. This style of lamp, as is evident, is adapted for street lighting and especially to places that are unusually exposed to the weather.

Converters in America.[1]

By Prof. Forbes.

Having been asked by the society to add some further account of the manner of working converters in America, I will now briefly comply with that request.

Engines and Dynamos.—It is a mistake to suppose that one or two large engines are more economical than a number of small ones. A large engine working far below its power is very wasteful of steam.

One engine drives one dynamo by belt direct, without countershafting. It is well to have each unit in a station of the same size, so that parts are interchangeable, and the attendant has less to think of. The size of unit may be chosen so as to supply, at efficient load, the minimum current required in the 24 hours. One exciter is generally used for four machines in series, with an adjustable resistance. A shunt resistance, largely made up of lamps, may be put on each field for regulation.

Feeders.—These are generally overhead. Waring cable underground (lead covered) is perfectly successful. Simplex wire is generally used for overhead work. Five or six feeders are often fed by one dynamo. A loss of two to two and one-half per cent. of potential is generally adopted. Double bell insulators are used.

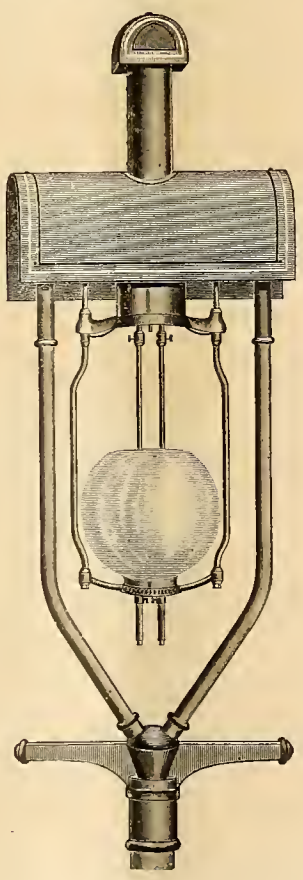
Converters.—These are made for 5, 10, 20, 30, and 40 lights. The wiring of a large house is best done with separate circuits for each 40 lights. It is unadvisable to bank, or group in parallel a number of converters. These converters are very light, and have a smaller quantity of iron than might be thought good. They reduce the potential from 1,000 to 50 volts. The primary and secondary fuses are put inside the converter. The mode of manufacture of these has been described elsewhere. The insulation between the primary and secondary coils is indestructible.

Lamps.—It is found that 50 volt lamps last longer than those with thinner filaments, and are generally used. The potential in the primary is 1,000 volts. No man has ever been killed by a 1,000 volt alternating current. It is well here to mention that you cannot get an arc from the low potential circuit when an alternating current is used.

Meters.—The Westinghouse company has made such arrangements as will enable them to charge customers by means of the coulomb-meter.

Station Ampere Meters.—The same instrument as Edison uses is adopted, but with a bundle of wires sucked into the coil. Both the bundle and the coil form part of an arc of a circle, and the former moves on an axis at the center of the circle. The force of the current acts against the weight of a counterpoise, and an index indicates the amperes.

Station Voltmeter.—A three-point converter reduces the potential either ten-fold or twenty-fold. A compound wound compensator reduces the measured potential to that at the center of consumption. The voltmeter is solenoidal in action, and is true only when the speed of engine is quite constant. The wire bundles for these solenoids are ingeniously constructed. A metal cylinder is covered with varnished paper or muslin. Iron wire is wound round the cylinder, sticking to the varnish. The iron wire ring thus formed is cut through and a flat web of iron wire is produced, which can be cut into lengths and rolled into bundles.



Ground Detector.—The converters have a lamp on each secondary. The primaries are connected in series to the mains. The intermediate contact is connected to earth. If one of the mains has an earth its lamp goes out. A multiple switch is provided by which each circuit can be tested in turn.

Synchronizer.—To synchronize any two dynamos, secondary wires are led to a switch-board. A wire from one converter is connected to a wire from the other. The two other wires are connected through two lamps. If the connected wires are in the same phase, the lamps go out. A switch is provided by which, as soon as the lamp goes out, the second dynamo is connected to the mains of the first. The dynamos work well in parallel from half to full load. Allegheny station sometimes calls to Pittsburgh, across the river, for assistance in current, and the synchronism is good. Synchronism is found to be quite satisfactory from half to full load, but not below.

Switch-Boards.—A switch-board is generally set up for each dynamo, and for five or six feeders. The conductors going to feeders run up and down; those going to dynamos are horizontal. The dynamo wires are connected with three instruments in a vertical row—an ampere meter, a converter, and a voltmeter. Each feeder has a vertical row of instruments, a three-point converter, a compensator, and a voltmeter. There are six switches for six feeders in a horizontal row, to switch any feeder into either of two pairs of dynamo conductors. One of these pairs is connected to the switch-board dynamo; the other can be connected, by means of a switch at the side of the board, to the conductors of either of the neighboring dynamos. An adjustable resistance, with six lamps in series for additional resistance, is at the bottom and middle of the board, and acts as a shunt on the field magnets. Another adjustable resistance is in series with all the field magnets. Another switch connects either of two exciters with the field magnets.

There are some other devices connected with street lighting and theater lighting which I am not at liberty to describe, owing to the English patents being not yet completed.

[1] Postscript to the Discussion on "Central Station Lighting," by the Society of Telegraph Engineers and Electricians.

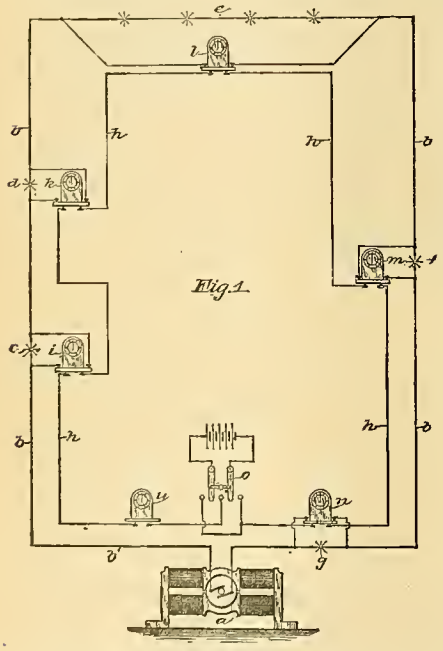
Edison's Phonograph in London.

Col. G. E. Gouraud, of London, who received one of the Edison phonographs last week, writes concerning the instrument as follows: "At 2 o'clock this afternoon at the above address I had the honor to receive from Mr. Edison his first perfected phonograph, which, on the authority of Edison's own statement, in his own familiar voice, communicated to me by the phonograph itself, is the first instrument on his latest model that has been seen outside of his laboratory or that has left his hands, and is consequently the first to reach this country. At five minutes past 2 o'clock precisely I and my family were enjoying at once the unprecedented and astounding experience of listening to Edison's own familiar and unmistakable tones here in England, more than 3,000 miles from the place where he had spoken, and exactly ten days after the voice—having meanwhile voyaged across the Atlantic Ocean—had uttered the words. His first phonogram, as Edison puts it, tells me, among other things of interest, that this instrument contains many modifications of that which was shown at the Electrical club in New York a few weeks ago, so widely reported by the press. There were several long phonogramic communications to me, no single word of which had to be repeated in order to be clearly and easily understood by every person present, including a child seven years old. Edison mentions that he will send me phonograms by every mail leaving New York, and requests me to correspond exclusively through the medium of the phonograph, humorously remarking in this connection upon the advantage he will himself derive from the substitution of phonograms for a style of writing not always too legible. Edison has sent for our amusement numerous musical records of great interest and beauty from the pianoforte, cornet, and other instruments, solos, duets, etc., many of which, he teils me, have been frequently repeated several hundred times. Altogether, our experiences of the day have been so delightful and unusual, not to say supernatural, that it would make it difficult to realize that we have not been dreaming. It has been so interesting withal as to make it seem a duty, as

it is a pleasure, to communicate the above to your widely read paper, which I have so frequently observed to chronicle the works of the author of this unparalleled triumph of mind over matter. All honor to Edison." Col. Gouraud adds the following postscript: "It may be interesting to add that the above communication was spoken by me into the phonograph and written from phonograph dictation by a member of my family, who had, of course, no previous experience with the instrument."

Device for Cutting Lamps in or out of Circuit.

In arc systems of electric lighting the lamps are placed in series. Fifty or more lamps may be placed in the same circuit. These lamps, however, will be distributed among several different customers or users, and the different users are charged a rate which is determined by the duration of service. For example, at one place of business lamps may be required until eight o'clock in the evening, and at another until twelve o'clock. It is therefore necessary to provide for cutting out the lamps of different customers at different hours, in order that there may be no useless burning of the lamps. It has been usual to send an attendant from point to point along the arc circuit to cut out the lamps of different customers at different times. In certain cases customers have no need of service



in the early part of the evening, and therefore it has been necessary to send a man to switch the lamps of such customer into circuit at the proper time. It has also been attempted to determine the duration of service of lamps of different customers by the amount of carbon consumed, leaving the customers to cut the lamps in and out of circuit at will. This latter method of determining the service has been found unsatisfactory, by reason of its inaccuracy and the liability of customers to make mistakes as to the actual duration of the service. For these reasons it is of great advantage to absolutely control the time of service from a single point, preferably the central station. This has been accomplished, as shown in letters patent issued to B. E. Sunny, president of the Chicago Arc Light and Power company under date of June 26, by means of an independent circuit extending to different users' stations in connection with an electro-magnetic switching device at each of the stations operated by current sent over the independent circuit from the central station.

The invention is illustrated in the accompanying drawings. Fig. 1 is a diagram showing a single arc-light circuit with a series of arc lamps included therein, with an independent circuit passing from the central station through the different users' stations and switching apparatus, whereby any one or more of the lamps may be cut in or out of circuit at pleasure. In Fig. 2 is shown in detail a polarized switching device, in connection with circuit opening mechanism, for cutting lamps in or out of the arc circuit.

Referring to Fig. 1, the dynamo electric machine *a* supplies current to the circuit *b*. This circuit *b* may contain any desired number of lamps. Five users' stations are shown upon this circuit *c*, *d*, *e*, *f* and *g*. The circuit *h* extends through the circuit changing devices *i*, *k*, *l*, *m* and *n*, placed respectively in connection with different users' stations. By means of a pole changing switch, *o*, current may be sent in either direction as desired, over the circuit. By means of the electro-magnetic switching devices at the different stations included in the independent circuit the lamp or lamps of any subscriber may be cut in or cut out of the lamp circuit by sending current over the independent line in the proper direction.

In Fig. 2 are shown a lamp, *p*, in an arc circuit and a shunt wire closed by the same, the shunt wire including the armature lever *q*, which forms a part of the polarized electro-magnetic switch. The pole changing switch *o* is arranged in such manner that when turned to the right current will be sent in one direction and when turned to the left current will be sent to line in the opposite direction. Armature lever *q* is shown in its normal position, the lamp *p* being cut out.

Referring to Fig. 1, it will be understood that a similar polarized electro-magnetic switch is provided in connection with each of the different clocks shown.

The magnet *r*, shown in Fig. 2, is usually termed the "starting" magnet of the circuit opening mechanism, since when it is energized, its armature, which carries the dog *s*, is lifted so as to start the mechanism. The circuit opening mechanisms are thus all started simultaneously. The cams, however, are placed in different positions, so that the shunt wire around the electro-magnets of the polarized electro-magnetic switching device of one mechanism only will be brought into circuit at once. The time during which any particular magnetic switch is included in the circuit is indicated upon the time indicator *u* at the central station. Thus while the pointer of the indicator *u* is passing over the space during which the shunt wire *w* of any particular indicator is open, the operator, by means of the switch *o*, may send current in the desired direction to cut out or to cut in the lamp or group of lamps of that particular station.

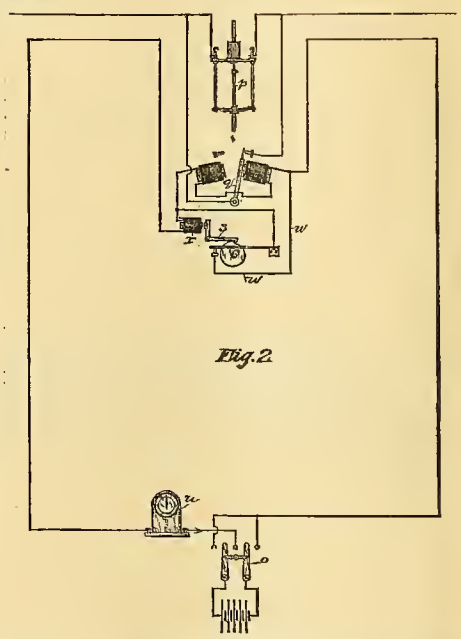
By providing a polarized electro-magnetic switching device, as described, the different lamps may be brought into circuit, or disengaged from the circuit. If the device were not polarized, the armature *q*, which is a permanent magnet, could be moved positively only in one direction.

The Electric Launch

A novelty seen in New York harbor during the last few days is a trim little pleasure boat, 28 feet by 6, driven by electricity. But unfamiliar though it may be on this side of the ocean, this motor has more than once been used for small boats, says the New York *Sun*. Several years ago a launch was fitted with electric motors on the Thames, and made many trips there, carrying a large number of passengers. Soon after, at the Vienna exposition, either this same craft or another of English make, plied constantly in pleasure trips, working to general satisfaction. An electric boat was then built by Yarrow & Co. for the Italian torpedo service. It was thirty-six feet long by six and one-third feet beam, its propeller being driven by a duplex Reckenzaun motor, and it achieved a speed of about eight and one-half miles. It was put in service at Spezzia. This vessel was surpassed in celebrity by the Volta, which first achieved the distinction of a trip across the British Channel and back, between Dover and Calais, a distance of about twenty-four miles each way. The Volta was about thirty-seven feet long by seven feet beam and three and one-half deep, and had a battery of sixty-one cells. It could be worked by a single person by simply turning an iron handle to the right or left for steering, while this switch also started and stopped the vessel. Practically the same arrangement is found in the launch used in New York harbor.

The time has not come, of course, for any general substitution of electricity for other motors on shipboard. In order to produce the degree of power required for large vessels it would be more expensive than steam, and the required power could not always be obtained. The speed thus far reached by electric boats is much inferior to what is possible with steam, so that even in the smaller class of pleasure craft, which might employ it, the eagerness for high speed continues to give steam the preference.

Nevertheless, there are certain advantages in the electric launch that may gradually increase its use, especially for specific purposes. One of these advantages, which will particularly recommend it for pleasure boats, is the total absence of smoke, heat, and escaping steam. This will cause the electric boat to have a great attraction for those who cannot endure the smell and other annoyances of steam machinery. The wheeze and thump of the steam engine are also lacking in the electric motor, and those to whom the monotonous noise of machinery is a drawback in yachting, will appreciate this feature. Then, under the system of storage batteries, which accumulate all the power required at the start, nothing could be simpler than the handling of the boat. The electric launch also has a greater passenger capacity than a boat propelled by steam, whose engines, boilers, and coal bins take up a space greater than that occupied by the electro motors and accumulators. These latter, in fact, can be packed away out of sight, hardly representing much more space and weight than ballast.



Some of these considerations, particularly the absence of noise and smoke, point to the uses of the electric launch for torpedo service, and in general for naval operations where the greatest secrecy is desired. With these advantages secured, the greater expense of using electricity would be of little consequence to a government, although it might prevent its introduction for ordinary commercial purposes. The failure to achieve high speed would be more of a drawback for government purposes, yet it might still leave sundry advantages for electricity in special directions. At all events there is likely to be a field for electric launches in the future.

Railroad Telegraphers' Convention.

The delegates to the Railroad Telegraphers' convention at Indianapolis, and visiting members attended Plymouth church last Sunday forenoon, June 24, by invitation of the pastor, Rev. O. C. McCulloch. In the afternoon they were taken around the Belt railroad and shown the workings of that road and the stock yards.

The session was concluded Monday afternoon, leaving considerable unfinished business, which was carried over to the next annual meeting.

It was decided to remove the headquarters of the order from La Porte City, Iowa, to Vinton, Iowa, where the order is given a ten years' lease of suitable quarters and moving expenses to the amount of $500.

It was decided to change the time of meeting

to the month of May, instead of June, to take effect in 1890.

The *Telegrapher*, the official organ of the order, which heretofore has been published as a private enterprise, now becomes the property of the association, and will be improved.

In addition to the insurance and sick benefit features, the association has an employment bureau which procured employment for over 200 members last year.

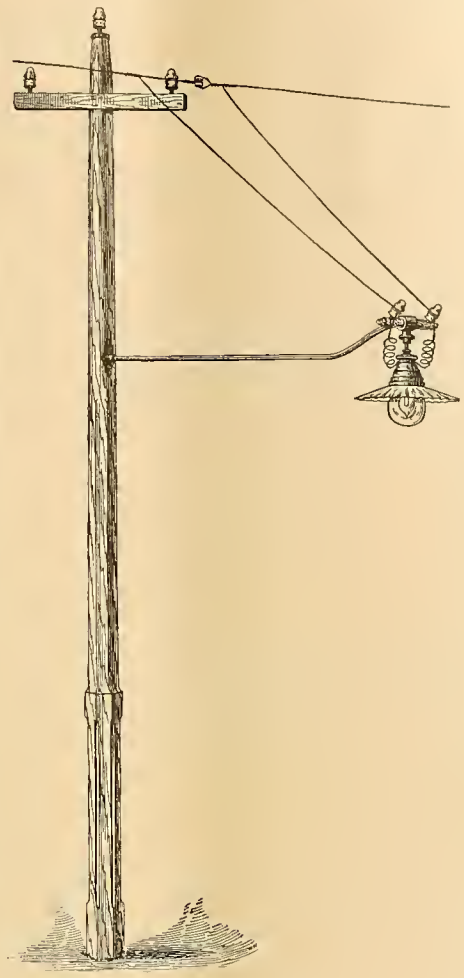
The Heisler System at Wabash, Ind.

The Heisler incandescent plant for the illumination of the city of Wabash, Ind., was completed last month. One hundred and thirty-two lights of 30 candle power have been placed at each intersection of the streets. The circuits extend over an area of twelve miles, number 8 wire being used throughout. The street fixtures are directly attached to the poles in substantial fashion, supported by iron castings made for that purpose, each light being at the height of about 12 feet above the ground.

Wabash was the first city in the United States to adopt the tower system for the illumination of the streets. It was not long, however, before improvement was sought in the direction of better distribution of light by using a greater number of lights of small candle power at a regular and suitable distance from each other, and of obtaining an equal amount of illumination in every part of the city, no matter how remote from the center.

A number of prominent citizens formed a company for the purpose of supplying the city and commercial and private circuits from one central station by incandescent lights of this system. The steam plant which had been used for the arc lights on the tower, consisting of a 45-horse power engine and a 50-horse power boiler, was turned over to the company and has proved sufficient to supply not only the street illumination over the whole extent of the city, but also a plant of about 200 lights of 20 and 30 candle power for stores and private residences. This demonstrates plainly the financial strength of the new enterprise, considering that the entire energy of the steam and electric plant is utilized for lighting the streets and sidewalks with satisfaction to the tax payers, and enough capacity left to light the interior of the commercial part of the city.

The Wabash *Times* under date of June 15th has this to say of the new system: "Wednesday evening, when but few citizens were expecting it, the electric light was turned on. The contractors completed their work Wednesday afternoon and decided to surprise the citizens by illuminating the city without notifying any one of their intention. There is no denying the fact that the present illumination is a great improvement over the tower plan, as used by Wabash for nearly if not fully eight years. The Heisler light is suitable for both street and indoor illumination, and the large number of lights now used insures a more thorough illumination of the city than could possibly be obtained by the other plan."



HEISLER STREET FIXTURE.

ILLUMINATION BY THE HEISLER SYSTEM.

HEISLER LAMP DISTRICT.

Electric Storage.

By Philip Atkinson, Ph. D.

PART III.

Faure's Secondary Cell. — About 1880, Camille A. Faure, another French electrician, constructed a cell similar to Planté's, in which he substituted plates prepared by a mechanical process for those prepared by the electric process. His method consisted in coating their surfaces with a paste of red lead (minium, Pb_3O_4) and sulphuric acid, which, when subjected to electric action, was rapidly reduced to peroxide on the one plate and spongy lead on the other. After this coating was applied, it was covered with paper, and each plate then enveloped in felt, to retain the coating on the surface, and to insulate the plates from each other. They were then rolled together and placed in the acidulated water in the cell and subjected to electric action with reversal; and in a few days, the cell was ready for use.

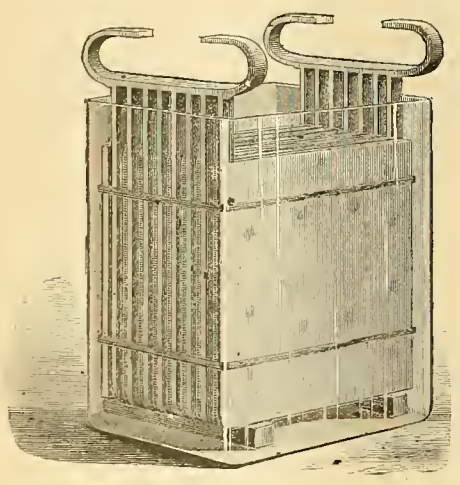
Chemical Reaction in the Faure Cell.— The chemical reaction in this cell, as described by Gladstone and Tribe, is very similar to that in the Planté, but differs in the preliminary stage. The minium on the plate connected with the positive pole is reduced in part to peroxide by the absorption of two atoms of electrolytic oxygen, which being added to the four oxygen atoms of the minium, make the oxygen atoms double those of the lead; $Pb_3O_4 + O_2 = 3PbO_2$. But the sulphuric acid reduces part of the minium on this plate, as well as on the opposite plate to sulphate, and this sulphate on the opposite plate is, in turn reduced to spongy lead by the hydrogen, as in the Planté cell. The reduction of minium to sulphate by the acid is as follows: $Pb_3O_4 + 2H_2SO_4 = PbO_2 + 2PbSO_4 + 2H_2O$.

The great advantage then of the Faure cell over the Planté consists in the rapid reduction of minium instead of the slow reduction of metallic lead, thereby greatly reducing the cost. This cell when subjected to practical tests was found equal in energy to that of Planté's, and it received the sanction of electricians of the highest standing, while its cheapness and facility of construction commended it at once to popular favor. The invention of the dynamo, too, having greatly reduced the expense and increased

the facility of electric generation, the great problem of the supply of electric energy, at economical rates, for general use as an illuminant and a motor, was apparently solved, since the electricity generated by the dynamo could be stored in the battery, to be transported and used wherever required for the propelling of cars or boats, the operation of light machinery, and the illumination of dwellings and offices.

Faults of the Faure Cell.—But the new cell soon developed serious faults which had to be overcome before these ends could be realized. The coating could not be made to adhere to the surface with proper uniformity, but sloughed off, partially, and collected in a mass at the bottom of the felt envelope. The space between the plates, being entirely filled by the felt, the free circulation of the electrolyte, necessary to the proper action of the cell, was impossible; and the felt, becoming corroded and partially removed in spots by the acid, soon ceased to act as an insulator, short circuiting ensued, and the cell became worthless. But the rapid preparation of the plates by mechanical process was a very important step in advance of the slow electric process of Planté; and while the disappointment at the failure of the battery was as great as the enthusiasm with which its first appearance was hailed, electricians, confident of ultimate success, still worked patiently to overcome the faults which had been developed

The Improved Faure Secondary Cell.—The various improvements of Swan, Sellon, Volckmar, Shaw and others, from 1880 to 1886, resulted in producing the improved cell shown in Fig. 6. It is made of different sizes, and with a variable number of plates, according to the purpose for which it is intended, the standard



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type here shown being known as the 15 A cell. It consists of fifteen plates, seven positives and eight negatives; those plates being known as positive which are connected with the positive pole in charging, and from which the external current flows in discharging, and the others being known as negative. Each positive plate is nine and one-eighth inches high, eight and one-half inches wide, and one-fourth of an inch thick, and each negative nine and seven-eighths inches high, nine and one-half inches wide, and three-sixteenths of an inch thick. They are made of lead, cast in the form of grids, with square openings to hold the paste, as shown at *A* in Fig 7, this form being the invention of Sellon. Each opening is three-eighths of an inch square at the surfaces, but smaller at the center, the walls being thicker, sloping inward from each surface, as illustrated by the cross-section shown at *B*, an improvement made by Sellon to prevent the paste from dropping out. These openings are filled with the paste of lead oxide, and sulphuric acid; minium, Pb_3O_4, being used for the positive plates, and litharge, PbO, for the negatives; each plug being held in its place by the peculiar form given to it by the opening.

From one of the upper corners of each plate a lead bar extends, as shown in Fig. 7. It is seven eighths of an inch wide, the same thickness as the plate, and extends two and five-eighths inches above the highest plates. These vertical bars on each set of plates are attached to a horizontal bar of the same width, as shown in Fig. 6, connecting the plates of each set together, and keeping them a given distance apart; the space between each two positives being nine-sixteenths of an inch, and that between each two negatives ten-sixteenths; each set, with its bars, being made as a single casting. The horizontal bars are extended and the ends turned in for convenience, as shown in Fig. 6, forming lugs for connecting the cells into a battery as explained hereafter.

When the plates are ready to be set up, the seven positives are pressed in between the eight

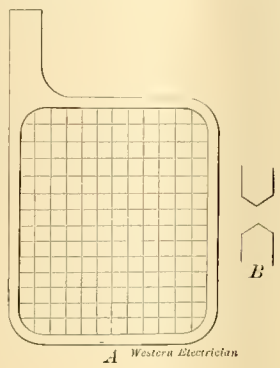

FIG. 7.

negatives, so that they alternate, each positive being between two negatives with a space three-sixteenths of an inch wide between them. In Fig. 6, the positives are shown with the bars to the right and the negatives with their bars to the left. As the outside plates are negatives, and the outside surfaces inactive, the same number of active surfaces positive and negative, fourteen in each set, are adjacent to each other within.

In each negative plate a number of openings are left without paste, and into these are drawn plugs of soft rubber, which project three-sixteenths of an inch on each side, resting against the positives, and holding the plates that distance apart. Two plates of glass, of the same size as the lead plates, are placed outside, one on each side, against the projecting rubber plugs to keep them from being pressed out, and all the plates are bound together and held in position by strong rubber bands which pass around them. They are then placed in a glass jar eleven inches long, eight and a half inches wide, and thirteen inches high, outside measure, and rest on two strips of wood placed in the bottom to allow free circulation of the fluid.

The Fluid.—The fluid consists of dilute sulphuric acid, having a specific gravity of 1.175, about thirty-six per cent. of acid to sixty-four per cent. of water. It covers the plates to the depth of half an inch above the upper edges of the negatives, and a coating of paraffine on its surface prevents the acid spray, to which the cell is liable in charging.

Electric Formation of the Plates.—In the electric formation of the plates at the factory each set is charged separately, a set of temporary plates, or dummies, of each kind being used with each permanent set. As the formation of the negatives requires a much longer time than that of the positives, litharge is prepared for them, being far more rapidly reduced than minium which is used for the positives. But this difference of material compensates only partially for the difference in time; the negatives requiring six days for the reduction of the litharge to spongy lead, while the positives require only twenty-four hours for the reduction of the minium to peroxide. But the use of the dummies prevents any inconvenience which might arise from this source, and renders the old process of reversal unnecessary. After the plates have been formed in this way they are partially discharged before shipment, and require to be properly charged when the cells are completed and ready for use.

Electromotive Force, Resistance and Current of Cell.—The average e. m. f. of the cell is about two volts, its internal resistance from .001 to .005 of an ohm, and its working capacity 350 ampere hours. The current varies with the external resistance, and the rate of discharge can be regulated by the resistance. A medium rate gives the most satisfactory results, and is found to be the most economical. Hence while a current of 300 amperes can be obtained and the cell discharged in a little over an hour, such a rate is wasteful, and would soon injure the plates, while with a thirty-five ampere current the cell will do efficient work for ten hours, without waste or injurious results.

It has been shown that the electric energy obtained by the discharge depends on the coincident chemical reactions, and that these reactions require time for their normal development; hence if the discharge is too rapid there will be abnormal chemical reaction with corresponding waste and injury. For the same reason a medium rate of charging which allows sufficient time for the complete chemical reduction of the gases is the most economical, while with too rapid a rate, a portion of the gas escapes and is lost. The same result follows from overcharging, though in either case there is no injury to the plates, since there is no excess of chemical reaction as in discharging. As a result of the charging a residual amount of gas adheres to the plates, oxygen on the positives, and hydrogen on the negatives, which does not enter into chemical combination; this increases the initial e. m. f. of the discharge to 2.25 volts, but as this gas is soon reduced the e. m. f. falls rapidly, so that at the end of the first half hour it is about 2.04 volts, after which it remains nearly constant for several hours, gradually declining to two volts or less. When the cell is nearly discharged the decline becomes very rapid, and if the discharge is continued when this stage is reached, permanent injury to the plates is the result, hence the discharge should be stopped when the e. m. f. falls much below two volts.

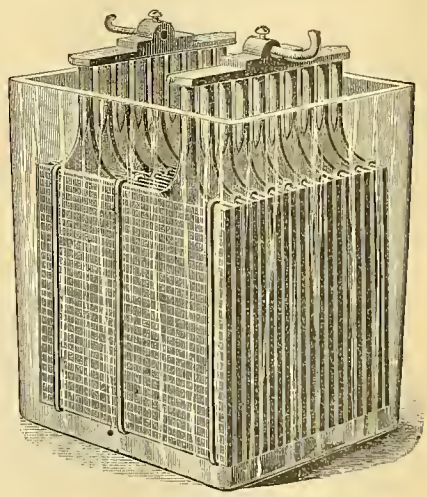

FIG. 9.

Weight of Cell and Thickness of Plates.—A cell of this type weighs 125 pounds. By making the plates half the thickness of those here described, positives one-eighth of an inch, and negatives three thirty-seconds, the weight can be considerably reduced, and such cells can also be charged more perfectly, the interior of the paste being made accessible to chemical reaction. But such plates have not the strength, rigidity or durability of the thicker plates; the paste is more liable to drop out, and they are less able to resist the tendency to buckle.

Cause of Buckling.—Buckling is a result of the formation of sulphate in discharging, producing unequal expansion. If it were possible to obtain perfect uniformity in the material of the plates, and in the solution, so that the expansion in discharging, and the contraction which follows in charging should be uniform, buckling could not occur. But like every other species of warping, it is a result of want of uniformity either in the material or in the action to which it is subjected, or in both. The acid, from gravitation, becomes denser in the lower part of the cell, and this affects both the chemical reaction and electric conductivity, both of which is greatest when the acid is most dense; and observation on buckled plates shows a curving from top to bottom, steadily increasing downward. But buckling does not interfere with the action of the cell until it has proceeded far enough to pro-

duce short circuiting, by bringing plates into contact, or displacing plugs of paste.

The pressure of the rubber plugs at numerous points tends to prevent buckling and to maintain evenness of surface; keeping all the plates everywhere at equal distances apart; while the rubber bands, by their elasticity, keep the pressure uniform, so that if buckling occurs it is likely to affect all the plates equally, in which case short circuiting cannot occur. The rubber bands and plugs have also the very important qualities of being good insulators and practically indestructible in the acid.

Variable Resistance of Electrolyte.—The expansion of the plates while discharging is the result of the absorption of sulphuric acid to form the sulphate, and the acid absorbed in this way during the discharge is restored during the charging; from which it is evident that the conductivity of the electrolyte is subject to continual variation; steadily increasing during the charging until the full proportion of acid is restored, and declining during the discharge as the acid is absorbed; consequently the internal resistance of the cell varies inversely in the same ratio, and hence the necessity of the large percentage of acid used, that the resistance during the discharge may not become so great as to lessen the practical efficiency of the cell, as a smaller percentage would be liable to entire absorption before the termination of the discharge, leaving only water which has a very high resistance as compared with that of dilute acid.

Too large a percentage of acid is also detrimental by producing an excess of sulphate, and consequent buckling of the plates during the discharge; so that the proper proportion to be used is of great practical importance, and the thirty-four per cent. already mentioned, seems to give the best practical results.

Inspection.—As short circuiting is liable to occur from a loose plug becoming fastened between two plates, or from a buckled plate coming into contact with an adjacent plate, frequent, careful inspection is necessary, and this is greatly facilitated by the glass jars, and the form and position of the plates, permitting inspection of the whole interior of the cell without disturbing its contents.

Formation of the Battery.—The projecting bars, vertical and horizontal, shown in Fig. 6, constitute the plates, the positive being painted red and the negative black to distinguish them. The cells being conveniently arranged for connection, as shown in Fig. 8, the positive poles alternating with the negative, if they are to be joined in series, the lugs, shown in Fig. 6, are bent outward and bolted together, the positive to the negative of the adjoining cell, as shown in Fig. 8, care being taken to have the connections bright and clean, and the lugs being curved, as shown, to allow for expansion and contraction. The different methods of joining the lugs, shown at *a*, *b* and *c*, are chiefly a matter of taste and convenience, though the greatest curvature shown at *b* and *c* gives more opportunity for expansion and contraction of the metal without disturbing the plates, than the method shown at *a*, while the latter has the advantage of being more compact.

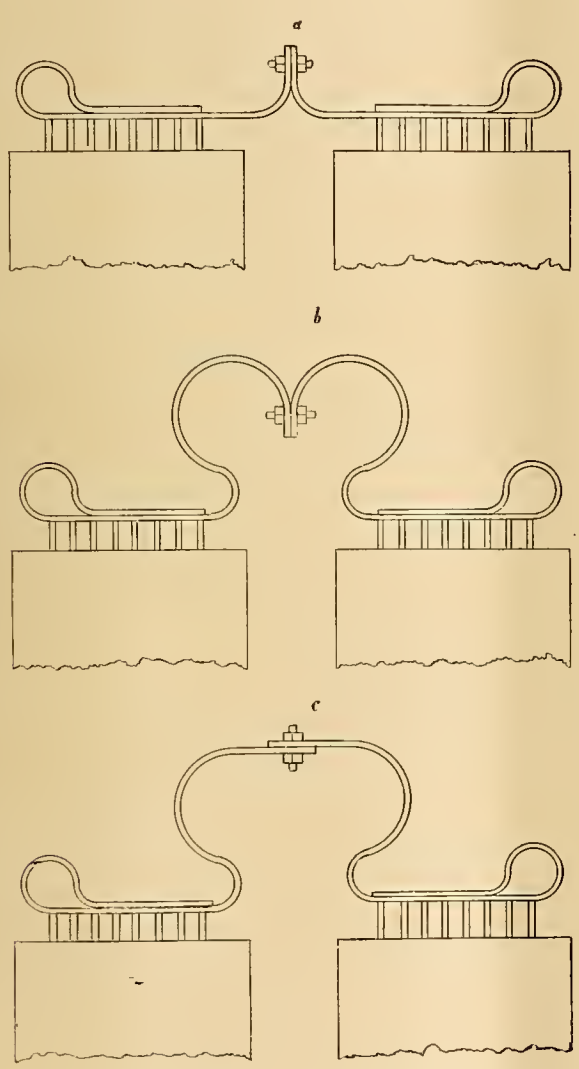

FIG. 8.

The Julien Accumulator.—The Julien accumulator, or storage battery, illustrated by Fig. 9, is the invention of Edward Julien, a Belgian engineer. Its general principles of construction and operation are essentially the same as those already described, but his specific claim is that the grids or supporting plates are made of a special metallic composition which prevents oxidation and buckling, giving the battery much greater durability than can be obtained by the use of lead grids. The nature of this composition, known as "L'Electrique," is a business secret.

(Concluded.)

American Institute of Electrical Engineers.[1]

Prof. G. W. Plympton's Paper.

PART III.

Prof. Plympton: The impression I have received from conversation with those who seemed to know, was, that a large part of the telephone service of Europe was buried in the streets. I was partly disabused of that idea by an engineer, who had returned from Europe just as I was setting out. I went to London. I was furnished letters to various engineers by engineers and managers of telephone and telegraph companies and civil engineers. I first made the acquaintance of Mr. Preece in London, and learned from him that the Postal Telegraph wires were buried in the streets, and that some telephone wires were buried with them—enough for the service of the postoffice department. A telephone company enjoying franchises in London have run all their wires overhead, as the manager informed me; he could not put a wire under ground without an act of parliament. They bought their right of way over the housetops. There are certainly wires enough in many places there. They do not compare in number and entanglement with ours in New York, simply because there is no such telephone service there as we are familiar with here, nor is there in any other place. I had submitted the question as to the material of the conduits. He said that after going through a good deal of experience they had adopted iron pipes for their conduits and drew their cables loosely through them. Wires were protected singly, and then two or three, or a dozen wires were twisted together and pulled through the iron pipe—generally a three-inch pipe—rarely larger than four-inch. If it was necessary to make connection at some point not contemplated before the pipe was put down, they simply knocked a hole in the side of the pipe with a hammer and made the connection. When inquiry was made what they would do in the case of so many subscribers along any line of telephone conduit, such as we have here in New York, they said that problem had not yet presented itself to them in London. I went on there to make another visit afterward. I simply examined the system in the streets. These pipes were buried about sixteen or eighteen inches, rarely as much as two feet, ending in little cast iron boxes about twenty inches by sixteen, and perhaps a foot deep, fitted with an iron cover tightly cemented. They sent workmen out and I was accompanied by Mr. Fleetwood to examine the boxes. They had difficulty in raising one or two. I asked why they were so tightly cemented. They said to keep water out. I asked if that was really the effect. They said they thought it was, but the first cover they took off showed me a box with about two inches of water in the bottom. In submitting the question of material of a conduit to Mr. Preece, he answered that iron was used because it would serve better to protect their wires from injury when the streets were dug up by workmen; pick axes would knock everything else to pieces. He spoke well of our plan of creosoted timber, and took from a case in his office a piece of an old conduit put down in 1853. It had been in the ground thirty-one years. It came out perfectly sound. The cable had given out years ago. It is known that they began systems of telegraphy in Europe by burying all their wires. They tried to bury them along their lines of railway; afterward dug them up and now their wires across the country are on poles.

Brussels I visited next and there found a system of arc lighting. Wires were stretched along the street. None were buried. Telephone wires are over the housetops, the wire being in some cases a hard drawn copper wire, in others a silicon-bronze. As the houses are high and the house attachments are high these wires run pretty well up in the air; and as they are small they do not attract attention as they do here. That is the case generally throughout Europe. They use a small wire and the housetop fixtures are so high that they are not apt to attract attention. A gentleman on the steamer gravely told me that he had been all over Europe and did not see any wires in the air at all; he knew they were all underground. As the chief manager of the telephone system was in Antwerp, I went on to Antwerp to get such information about such telephone service as was under his control. That was Mr. DeGroo. He very kindly offered his time to answer as many questions as I chose to ask. I thought of going to Stockholm for the reason that I understood the service was very good there, but I learned from Mr. De Groo that everything was put up under his direction, and with the exception of the framework on the housetops, everything in Stockholm was exactly duplicated in Antwerp. He thought that no telephone wires in Europe were underground except those that were in the sewers in Paris. He proved to be not quite correct, though pretty nearly so. I asked about his house top connections. He said that all through the Belgian and Scandinavian cities they were on housetop fixtures. In Italy they were on brackets under the eaves, for the reason that the tiling of the roof does not support these immense wooden structures very kindly. To preserve some degree of coolness in their roofs they put on a triple tiling, with little air spaces between the tiles, and it almost destroys the whole roof to put up a wooden structure. Hence they attach it by brackets under the eaves. The style of these you will have an opportunity to see, as I have had these systems extensively photographed in many places in Europe. Mr. De Groo added that one company had come there with an electric lighting system and had buried a cable for a short distance with the intention of lighting the street. It was all buried and they were nearly ready to start when the gas companies came forward and proved that they alone had the right to dig up the street—the right of canalization of the streets, as he expressed it. The whole plant was lost, and lies buried in the streets. He mentioned as an interesting fact that he tried a new plan along the shore of the Scheldt. He had just put up a mile of poles to support his wire. That was a pole line in Europe that they felt rather proud of. I had it photographed, and have received

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CONTENTS OF THIS NUMBER.

Page.

Arc Lamp Hood, Illustrated 1
Converters in America, by Prof. Forbes 1
Edison's Phonograph in London 1, 2
Device for Cutting Lamps in or Out of Circuit, Illustrated 2
The Electric Launch 2
Railroad Telegraphers' Convention 2, 3
The Heisler System at Wabash, Ind., Illustrated 3
Electric Storage, by Philip Atkinson, Ph. D., Illustrated, Part III, Concluded 3, 4, 5
American Institute of Electrical Engineers—Discussion, Part III, Concluded 5, 7, 8
Editorial 6
Practical Telephony, by Thos. D. Lockwood, Illustrated, Part XI 8
Successful Underground Arc Light Circuits, Communication by B. E. Sunny 9

DEPARTMENTS.

Correspondence 9, 10, 11
The Electric Light 11
The Electric Motor 11
The Telephone 11, 12
Electrical Patents 12

Vol. III.—No. 1.

With this number of the WESTERN ELECTRICIAN we begin a new volume and a new year. It is not, perhaps, necessary to call attention to what we have done in the last twelve months, as our work has shown for itself from week to week. Neither is it necessary to make the statement that the WESTERN ELECTRICIAN has succeeded. The fact is apparent.

We do think, however, that the magnitude of our success has been a surprise to many, and at this time it may be excusable if we give a few of the reasons why we have succeeded so remarkably.

In the first place we have kept all our promises. We promised a paper which should be kept up to a high standard and we have furnished such a journal. The WESTERN ELECTRICIAN is, and has been from the start, an expensive paper to publish, and in the future it will be still more expensive to its publishers; but this is what we promised, this is what we have done, and this is one of the things which have contributed to our success.

In the second place the WESTERN ELECTRICIAN is published in the right place. It is issued from the great central city of the country. The west, with its cheap coal, is the greatest electric light and electric power district on the face of the globe, and with its enterprise and push is a fruitful field for all kinds of electrical work. Chicago is the metropolis of this great section, and the WESTERN ELECTRICIAN is published in Chicago.

This is about all there is to say. A good field and a first class paper are the things which have made our success so pronounced. Of course we have worked, and worked hard, but we expected to do that. We might, however, have worked hard and failed, but a first-class paper, a first-class field and hard work together have given us a success which is indifferent but pronounced.

Now for the next year. There will be no let up on the hard work. Our field will be better than ever and so will the WESTERN ELECTRICIAN. We shall spend a good deal of money on the WESTERN ELECTRICIAN during the next twelve months. We shall give our electrical newspaper friends a few more pointers on mechanical and typographical excellence. Since the WESTERN ELECTRICIAN was started every electrical paper published in this country has in some way improved its typographical appearance and endeavored to approach a little nearer to this paper in mechanical excellence. They never equalled us, but we shall now give them another boost. Notice this number. The type is brand new, although our old type had only been used one year. The white paper is heavier and better finished than that formerly used, although the other was more expensive than that used by any other electrical paper. And we have other improvements in store for our readers.

Watch the WESTERN ELECTRICIAN the next year. You will find it better, brighter, handsomer, more interesting and more successful than ever before.

THE New York electric light companies have become used to attacks from metropolitan papers, but they have not yet received much criticism at the hands of the electrical fraternity. Mr. Sunny, in a communication in another column, raps the companies soundly and tells them they deserve all the criticism which they have received.

THE projectors of the proposed Chicago underground railway referred to last week do not propose to "boom" the road. It is stated that no attempt will be made to begin work until an exhaustive investigation has demonstrated that the plan is feasible. The incorporators claim that if the investigation reveals the practicability of the undertaking capital will be forthcoming.

PRESIDENT SUNNY, of the Chicago Arc Light and Power company, has something to say about underground arc light circuits of interest to every electric light company. Taking as a basis a published interview with Prof. Henry Morton, of Stevens Institute, wherein he gives reasons why underground wires for arc circuits cannot be successfully operated, President Sunny proceeds to meet theory with practice, and to show that the undergrounding of arc light wires is entirely feasible.

THE residents of the west side in Chicago will be more anxious than ever to have an electric motor system after reading the particulars of the latest accident on the whimsical north side cable road. One of the strands of cable became twisted in the grip and the gripman was unable to stop the car. A collision followed and several persons were injured, though not seriously. If the cable continues to cut up capers of this kind the residents of the city will not desire to see an extension of the system, but will prefer to see some other mode of car propulsion experimented with.

THE somewhat detailed statement which Prof. G. W. Plympton gave in connection with the discussion of his paper on "Underground wires in Europe and America" by the Institute of Electrical Engineers is even more interesting than the paper itself. The fact that European countries are behind America in the matter of underground wires is one which will be received with surprise by many persons, as it was by Prof. Plympton when he went abroad to seek information on the subject. The professor quotes an Englishman as saying: "If I had been asked about the best place to go to to learn about underground systems I would have said, the United States. We haven't any here." The underground systems such as Prof. Plympton found were certainly not of such a kind that they could be followed as models. Nothing referred to seems to compare for a moment with the Chicago system described by Mr. Sunny in another column. Prof. Plympton's investigations extended over several countries, and the information is complete and interesting. In the discussion Mr. Powers made the statement that if the wires were buried four-fifths of the danger from electric wires would be removed at once.

SINCE the appointment of Schuyler S. Wheeler as electrical expert of the New York board of electrical control that gentleman has found work enough to keep him busily engaged. In two weeks he sent out 545 notices of existing violations of the law relating to wires. If the statements of the daily papers are to be relied upon, the circuits in the metropolis are in an exceedingly bad condition. The inspectors, it is said, have made daily reports of from forty to 100 dead wires. None of the wires has as yet been removed; it is the policy of the board to find out the companies to whom they belong and compel them to bear the expense of removal. If the owners cannot be located the board will remove the obnoxious wires. Complaints are made that when dead wires are found, current is turned on temporarily so that the wires will not be interfered with. Mr. Wheeler is reported as saying: "Our next move, after getting the dead wires out of the way, will be to remove all surplus poles. On many thoroughfares there are two, three, and sometimes even four lines of poles on the same side of the street, and we will make one set of poles answer. The department of public works is giving us hearty support now, and I think we will accomplish many reforms in the course of the summer and make much headway towards relieving the streets and insuring people against accidents from the wires."

The New York papers without reason continue to rail at the mayor and the board of electrical control and insist that they are fit subjects for indictment because of their failure to compel the companies to bury their wires.

A. K. STILES, of Chicago, who has had as wide experience with electric railways in America as any one, writes the New York *Tribune* the appended letter, which is a powerful argument in favor of the safety of electric roads: "Since you take considerable interest in the subject of electric railways and have been publishing communications as to their safety, I would like to be allowed to say that the impression which has been carefully cultivated in some quarters about the number of accidents is wholly unfounded. In this country alone electric roads have now carried, it is estimated, some 25,000,000 passengers, not a single one of whom has been hurt. The alleged accident at Jamaica, L. I., where a woman was scared by the dropping of a trolly on the roof of the car, is too absurd to be seriously noted. Outside of that there are, I believe, two instances in which it is asserted a horse and a mule have been killed by direct contact or entanglement with a large extent of conductor that had fallen. I venture, therefore, to assert that no other method of travel in our cities can show a record to compare in any way with the electric for ease and safety. In regard to the assertions of J. Murray Mitchell as to what the English Board of Trade does in limiting the potentials of currents, I must state that he is sadly misinformed. I could mention a great many places in England where potentials eight times as high as he names are in use in connection with American systems of electric lighting apparatus. As to electric railways, the English are as yet practically without any, but where they have been tried currents of 250 and 300 volts are in use, and with such conditions as we adopt here in America for safety, the Board of Trade is, to use its own language, 'prepared to authorize a difference of potential considerably in excess of this limit, with suitable precautions.' America need not go to England to learn how to operate electrical inventions."

(*Continued from page 5.*)

the photograph since. In Berlin, the circumstances are not widely different. There is a series of lines under the municipal direction, and some under the direction of the government. There has been a little friction between the two. The first official that I consulted assured me that all telephone wires were on the house-tops; nearly all telegraph wires were buried in the streets, and at no great depth; very much like the wires in London, in pipes, not far below the surface.

The German military telegraph is of another kind. That is the Siemens cable strongly wound with an armor and buried without any other protection directly in the ground. The telephone wires are very abundant in Berlin over the house-tops. There is quite a tangle of them, as you will see by many photographs here. I should add, that in Brussels, perhaps the most remarkable display of wires anywhere is shown by that photograph. [Showing a photograph.] It is a fine picture of their chief cathedral, with wires spread above and running a long distance to their support. In Berlin, the house-top fixtures are really very extensive. I have never seen any in New York which were able to carry as many wires at once, as those of Berlin. As the government controls the placing of the wires, they are frequently placed on their best buildings and some of the very fine views across their favorite avenues show these light iron fixtures on top of public buildings. The difference between the German service and that of Belgium is that in Germany the householder must submit to having the fixtures put on his house. He is paid, however, for the service. In Belgium they make the best terms they can, and the telephone companies pay at about the rate of ten cents per wire per year for the use of the house-top.

One picture represents Turin where there is a great assemblage of wires coming over the house-tops. In Brussels, one difficulty which Mr. DeGroo said he had experienced was from the disturbance of the wires by angry citizens. The wires were so thick that they killed a great many carrier pigeons. Owners of pigeons would get angry and go up on the house-tops, and chop the wires. Fifty wires were destroyed the day before. An old lady who owned a number of pigeons had destroyed them. Cologne has, I think, about fifty—it was August, 1886, that I was there,—and Frankfort about four hundred. Four, five or six hundred is about the number for those cities in Central Europe.

In Paris a different condition prevailed. I went directly to the electrician. I had letters from Mr. Edison and Mr. Vail introducing me to M. Berthou, in whose charge are all the telephone lines of France. I asked him immediately about his underground system in the sewers. He said, "Yes, they are in the sewers, but they are there because the sewers are right at hand." I asked him, "What do you do when you come to the end of your sewers?" He said, "Then we come out and go to the house-tops." A little later he showed me a wire drawn out of a sewer fastened to the side and drawn up to the house where it was wanted. I asked him what the plan was in other French cities. He said they were all on the house-tops, except at Bordeaux, where about three hundred subscribers are furnished by a system drawn through iron pipes, but they were not doing very well. I visited the sewers, and walked along through them some distance. I noticed the method of attaching. It was a little hook with a shank, driven into the wall overhead; I could just reach them with my hand. They would hold four or five cables as large as my thumb. There would be twelve or fourteen of those small cables in a single one of tbese sewers. It was easy to make out the distance of these cables as they branched off, because the sewers are very conveniently marked—the street corners are marked with the name of the streets. In regard to the arc lighting, I asked him if he would put the arc light wire in the same sewers with his telephone wires, and he said "No!" very energetically—he would not have them there; indeed he did not believe that arc lighting was going to prevail to any great extent, and then added, "We have less now in this avenue that you are in than we had three or four years ago; we have replaced the arc lights with the gas lights." The gas lights are in groups, five or six burners in each lamp. There were no arc light wires underground, so far as he knew. I noticed while walking with him along the street that there were some wires overhead. He said those were some of the dead wires not yet removed; but he called the superintendent, who was in sight, and submitted the question to him. The superintendent said, no; that the wires were overhead as there was no sewer in that street. It was a little street. Then M. Berthou added, "There are one hundred subscribers served that way;" and again the superintendent interposed to say that there were two hundred in Paris served over house-tops solely. He added in regard to the service that he expected to be able to extend it through Spanish cities; it was a franchise that he was expecting to control very soon, but he had made it a condition that he should be allowed to go on house-tops. So I got but little information with regard to the best way of burying wires until I got back to England, when, after a short stay, and another consultation with the electricians there, I went on to Newcastle. I was assured that they were beginning to put wires underground in Manchester. If I went there I should see that they were burying a cable in an iron pipe. Newcastle enjoys the reputation of having all its wires underground. They have a system of iron pipes. They serve some three hundred or four hundred telephone subscribers by the use of the wires. They are controlled by the government. They do not study economy in the method of hauling in wires or in the use of them. They twist their wires together so as to establish a metallic circuit, and run from their central station to their customers. I had got this estimate from both M. Berthou and Mr. Preece, that when the underground system was fully at work with cables the best that they knew how to make, the limit of service would be about ten or eleven miles underground. I asked if it would be profitable to run further than that if you come out of the ground at that distance. They said that was doubtful; it was a question not solved. M. Berthou stated about twelve miles as the limit at which it was possible to send a telephone message through anything buried in the ground. I mentioned that to the electrician who was assigned to me by Mr. Heavyside, the head of the telephone service in Newcastle, and he said, "I cannot quite accept that estimate, and I think I will give you an opportunity to refute it." So he connected up a line for me for experiment, which he said was a line of twelve and a half miles of cable, what he called cable—that is, a lot of wires twisted together in pairs; twisted a little way in one direction, and then twisted in the opposite direction. These pairs were put together until there would be about a dozen or twenty, and then they were pulled loosely through the iron pipe. At the end of the twelve and a half miles the wire came out of the ground and connected for about thirty-eight miles further. It was fifty miles and a fraction through which he said the telephone service extended. I could converse through that, though I found difficulty where an expert worker at the telephone would not. I could converse through that when the conditions were exceptionally favorable. It was in a padded room, and the instrument was in perfect working condition. I had no difficulty in conversing through that twelve and a half miles of cable and the ærial line up to fifty miles. Such telephone service as they have in Newcastle would hardly answer the purpose where there are so many users as we have here. I asked how they increased the number if they had additional subscribers—how they could pull more wires into the iron pipe that had a twisted tangle of wires already in it. He said they pulled the whole bundle out and sent them to headquarters—the postal department—and they furnished them a new lot. Economy was not considered. He said the government owned the whole thing.

MR. POWERS: As a central station operator I should be glad to ask what is the longest time—if there are any arc light wires buried underground—what is the longest time for which such wires have been buried up to the present time?

PROF. PLYMPTON: I cannot tell that. We have had no experience of that kind in Brooklyn. The arc light company appears to be ready to try experiments when it sees its way clearly. We have been more interested in getting the telephone wires underground, because they outnumber all the others.

MR. POWERS: There seems to be in this matter a very grave misunderstanding by the public about the danger of the electric light wires themselves. I have kept a close track of this matter since there has been some agitation of this question at Troy, and I have noticed that four out of five accidents occur not from the electric light wires directly, but from the coming down on the electric light wire of, I think, principally, abandoned wires overhead. The nuisance has become so great in Troy that a law was recently passed by the common council requiring the city engineer to remove those wires. We had one accident a short time since. An abandoned Atlantic & Pacific telegraph wire fell down across us and killed a horse, through no prime fault of the electric light company. If we can get the telegraph and telephone wires underground, which seems to be possible, we shall have, if the recent accidents are any criterion by which to judge, four-fifths of the danger removed at once, and I think that the question of danger will then sink into comparative insignificance.

MR. MAILLOUX: I would like to ask Prof. Plympton if he has any data regarding the working of the underground system at Chicago. I believe the underground system has been working there on a considerable scale. It might be interesting for him to tell us whether he has any personal knowledge about it. His treatment of the underground systems in Europe is certainly a very masterly and thorough, and comprehensive one, and there is but very little for us to say either by way of comment or otherwise. But it is quite evident to the minds of us all that they have not done anything in Europe that we can safely and conscientiously recommend for our own particular cases, because not only are the systems more numerous in this country, but they are also exploited on a much larger scale, so that a remedy which might be adequate in Europe would not be adequate here; and for tbat reason I would like to know what Prof. Plympton may have learned of systems which are promising success in this country.

PROF. PLYMPTON: I visited Chicago, and was very politely received by Mr. Barrett, who is superintendent of the work there. He said that he began by forming an agreement with various companies that they should bury their wires as fast as he buried the wires of the city. He is city electrician. He allowed the companies to select their own conduits, so that each company has its own. They have telephone wires, telegraph wires, underground electric light wires for some purposes. There is no municipal street lighting in Chicago, or was not a year ago last February. Some theaters and buildings are lighted, but they run through conduits. That was the case where one of these took fire. I wrote to Mr. Fay, and asked about the telephone service, to learn if they had suffered from induction, from proximity to any of these other wires. They had in some cases. The harmonic system of telegraphy had created some difficulty through its induction, and there had been complaints; but inasmuch as each company had selected its own conduit and buried its wires in its own way there was not much to gather about a general system of burying, or getting them into a compact shape as could be done. Indeed, standing at one of the street corners, one of the electricians pointed out to me fifteen manhole covers in sight at the junction of two streets, all within a radius of less than sixty feet. They have there a short way of making connection. Their soil is soft, light sand. They take a sharp pointed pipe and drive that pipe right across the street if they want to make a house connection. It may turn out in the middle of the track, and then they pull the pipe out and start again.

In regard to getting information from other sources, the remark made by Mr. Parish, in London, was significant. He said, "If I had been asked about the best place to go to learn about underground systems, I should have said, the United States. We haven't any here." I found that to be the case. They can come here to learn about underground systems. They cannot overtake our rapid development.

GEORGE S. MOLER'S PAPER.

PROF. NICHOLS: The session has been so long that I will ask just a moment on this subject. The galvanometer is one which was devised in the physical laboratory at Cornell by my assistant, Prof. Moler, for laboratory purposes; the object being to get a portable instrument which should have as large a range as possible, a fair degree of accuracy, and ease of manipulation. The plan which he suggested and which we have carried out in the construction of one of these instruments is shown in the diagram in connection with my last paper. Prof. Moler suggested that by using the coil of the galvanometer at the end of a swinging arm, you could at the same time cause it to recede from the needle, and without having to move it to a great distance you would be able by turning it through an angle at the same time to increase the constant of the instrument from a very small quantity, when the arm was vertical, to infinity when the arm was horizontal. It also occurred to us that it would be better to divide the quadrant, which is shown in these diagrams; a quadrant passing through this swinging coil, using constant deflections of the needle—calibrating for constant deflection of the needle. The results obtained by the galvanometer, I think, have been highly satisfactory. It has a single ring as a coil—a single bar of copper bent into a circle about three inches in diameter. When the arm has a vertical bearing, the coil being as near as possible to the needle, the deflection for one one-hundredth of an ampere is about eight millimetres, so that you cannot only detect the presence of one one-hundredth of an ampere, but you can make a pretty fair estimation of the amount of current. Starting from that as the maximum of sensitiveness of the instrument, and swinging the coil over away from the needle—the needle being a little bell magnet suspended in the usual way inside, and carrying a plain mirror—as you swing your little coil away from the vertical position, and bring it up to a position out here [indicating], the quadrant passing always through it so you can read it, the constant increases with great rapidity, both on account of the distance, which is increasing all the time, and on account of the angle which the coil makes with the horizontal plane, and the consequence is that with the sixty amperes we found we had not to traverse more than half of our quadrant, and the only element, so far as this part of the quadrant is concerned, is the current-carrying capacity of the conductor of which we make this coil. Just about forty-five degrees of this quadrant is divided between one one-hundredth of one ampere and sixty amperes, and the other would comprise all currents larger than sixty amperes. We have calibrated it only up to sixty amperes for a single deflection, but we find that the relative sensitiveness is nearly a constant quantity; that is to say, we can detect about the same proportion of sixty amperes that you can of one ampere. You can change in an instant from the measurement of a very heavy to a very light current by the simple process of moving that arm. For laboratory purposes this is oftentimes a great convenience. Of course it is not a standard instrument; but once calibrated it is fairly accurate. It is only subject to the objection that all those galvanometers have that you cannot move it around to the different rooms of a building without taking cognizance of the change in the horizontal intensity of the earth magnetism. In a laboratory containing iron, that changes through many per cent., and of course makes a serious difficulty. You can either set this on and then read upon the circular scale which is shown better in the diagrams than I can draw it—read the deflections as in any instrument, or you can select a constant deflection for which the calibration has been performed, and move the arm until you reach that deflection, or you can combine the two, moving the arm until you have approximated to the proper deflection, then reading the position and the difference here and making the correction for the difference according to the circumstances. Moreover, you can take this circular scale away and use a telescopic scale; or, finally you can project by means of a magic lantern on a screen to show the movement of the instrument. The current is brought in through the two arms in this ring, and these are hinged by means of two insulated screws here, and then it is carried from these screws off by means of a twisted pair of flexible cables for about a meter, and here are binding posts, and you can carry it off to a still greater distance with fixed cables. This is all one piece from this hinge up here and there around this loop and down the other side to the hinge and out again. There is a calibration curve that will be given in the publication of this paper which will show the degree of accuracy which we found it capable of, and I will not detain you by attempting to give the details of the measure—simply that for one one-hundredths of an ampere it shows a very sensible deflection, and it certainly will be quite sensitive, measuring a small fraction of one per cent. up to at least one hundred amperes, and to as much more as the coil would carry. [Applause.]

Adjourned.

"Sacramento is going to have an electric railway," said L. L. Lewis, connected with the Sacramento Cal. Electric railway, to a reporter, "and it will be something of which the capital city will be proud. I have ordered cars from the Electric Car company of America, whose immense works are at Philadelphia. There will be delay in obtaining some of them, as the electric portion of them must be made in France, but I have a contract by which one car, fully equipped, must be delivered in Sacramento by July 1. It will be a sixteen-foot, four-wheel car, with a storage battery of eight-horse power. The brakes, gongs, headlights—everything—are run by electricity. On Washington avenue, in St. Louis; Fifth avenue, New York, and in Philadelphia, I rode on electric railways, and they are the biggest thing out. The cars glide along without jolt or jar, and are under perfect control. The works in Philadelphia are unable to supply the demand for electric cars, and an addition for the exclusive manufacture of these cars is being made at a cost of over $300,000."

Practical Telephony.

By Thos. D. Lockwood.

PART XI.

2. The next case is where we find that the telephonic operations can be accomplished all right, but the bell cannot ring another, cannot drop the central office annunciator, or cannot receive a ring. The conditions, as stated, show first, that the line is all right or we could not talk over it; second, that inasmuch as none of the foregoing signaling functions are accomplished, the trouble is clearly either within the bell box, or else in that part of the circuit at the central station which is cut off during conversation: *i. e.* the annunciator, and that part of the line leading from the spring-jack through the annunciator to the general ground. Furthermore, it is clear that the trouble is not likely to be in the generator itself, since that is assumed to be cut out by its short circuit.

Try first, whether the fault is in the bell box; put in the cut out plug, or if that plug be lost at is usually the case, unite the two line posts by a short wire and ring. If the bell will not ring the break is inside; if it will ring, the trouble is on the annunciator section of the line at the central station, and ten to one in the annunciator coils.

Supposing, however, that the bell did not ring, locating the trouble within the box; you now open the box and look for it; it is clearly a broken wire and is not likely to be hard to find. If it should prove to be hard to find, it will do no harm to remember that although there is a shunt circuit round the generator coil, which is arranged to be broken by the turning of the crank, it is quite possible that this also being made of wood and metal like the rest of the mechanism, is subject to the laws of nature, and may become defective. The shrinkage of the wood may for example force apart the two ends of the shunt circuit, so that the generator coils are not cut out at all; in this case, talking is bad and the fault we are looking for may be there.

3. The ring which any subscriber's bell receives or gives out, is loud and strong, but the ring which its generator produces in other bells is weak; or when used to call the central office, the annunciator will not always drop. Clearly, here the only fault is in the generator itself. The fact that the home bell rings all right shows the circuit and bell when at rest to be in good shape; and inasmuch as the feebleness is only exhibited when a call is sent, we can reach no other conclusion than that stated. Either the generator is weak, in which case it should come out, and be sent to the shop for repairs, or it has loose connections which can easily be found, and which must at once be repaired.

4. The bell will both receive and transmit a call, but not so strongly as it should. What is wrong?

Try first, whether you can talk over the line using the telephones of the defective bell. If so, the probability is that the line circuit is in good order, and the fault is nearly certain to be a loose connection, or a dirty or otherwise imperfect switch connection inside the bell box. If this is found to be all right, examine the ground connection, as it is possible to talk, and sometimes to talk well, over a line having a resistance owing to loose connections, so high that the calling is done very poorly.

5. The bell makes a fine ring when a call comes in, but when the call is sent, the generator fails to ring its own bell.

This is really only a symptom of the same trouble as that numbered 3, and is due to the same cause; the generator is out of order.

6. No fault is noticeable when a call is sent; other bells are rung all right, and the central station always receives the call, but the home bell rings very feebly.

This sometimes occurs after a lightning storm during which the ringer magnets may be demagnetized; and is caused by weak magnets or by some bad adjustment in the armature. This point was fully explained in Part II.

7. The bell rings all right, and receives a ring all right, but when the telephone is taken from the switch, conversation cannot be either received or transmitted.

The main line is obviously in good order; if not you could not send and receive calls; and the trouble is thus at once located in the telephone branch.

Is it in the transmitter or receiver? Not in the mechanism of the transmitter or in the primary circuit, certainly. Why? Because you can't hear any better than you can speak, and therefore whatever the trouble is, it is common to both receiver and transmitter. It is the connection with such faults as this, that experience counts for something, and before making a close examination, experience teaches us to go at once to the weakest part of the telephone branch; namely, the flexible cord to which the receiving telephone is attached. There isn't much doubt that the trouble will be found there. If it proves that this cord is all right, then inspect the remainder of the telephone branch, the switch connections in the bell box, every binding screw, and all about the receiving telephone and the transmitter, taking especial care when you come to the place where in the latter instrument the two wires pass from the two right hand screw terminals to the induction coil. In studying this fault the junior inspector will do well to keep before his eyes the fact, that by the act of taking the receiving telephone from its support, the switch has been caused to connect the main line with the receiver and with the secondary coil of the transmitter, and hence the trouble must be in one of these instruments or in the cord.

Fig. 16 indicates generally the arrangement, but the reader must remember that there are many alternative ways of making the connections.

Flexible Cords.—A few words about the necessary flexible conductor will not here be out of place. The flexible conducting cord to which the receiving telephone is attached is mechanically one, but electrically two. It contains two

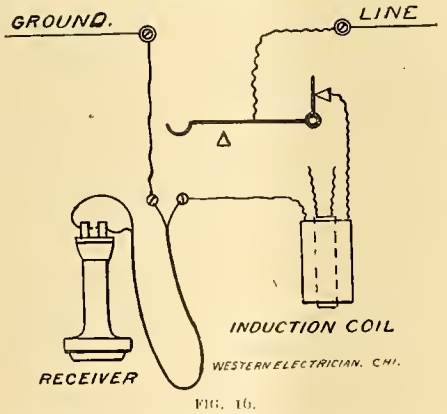

Fig. 16.

separate and independent conducting wires, each composed of spiral wires, usually steel for strength, with a string passing down the center of the spiral; the string now generally has copper tinsel wound upon it, so as to reduce the resistance introduced by the steel. Each of these conductors is separately covered with a braiding of cotton to prevent it from coming into contact with its companion, and then the two covered conductors thus protected, are covered with one or more coverings of braided silk or cotton of suitable color and texture to give it a neat appearance. Each conductor terminates at both ends in a metallic tip adapted by shape and size for insertion into a binding screw. The ends of the two conductors at each end of the cord are left unbound together for about three inches, so that each can conveniently be led to its own binding screw. The two tips at one end of the cord are fastened to the binding screws in the bell box, and the two at the other end to the binding screws of the receiving telephone. By this means, a loop—continuous and metallic—is formed which includes the telephone, and the voice currents pass from one of the bell binding screws down one of the cord conductors, to and through the telephone helix, and back by the other conductor. There are only two points in the cord where faults are likely to arise. These are at the point of connection between the flexible conductor and its metal tip, and at the crotch of the covering where the two conductors bifurcate; and to give the ——— subscriber his due, it is fair to state that he is usually responsible for defect in either place. If he gets into the habit of dropping the telephone, and letting it hang with its whole weight on the cord, it is by no means surprising that the connection between the tip and the conductor fails; and if he acquires the equally objectionable habit of hanging the telephone up by the crotch of the cord, we must anticipate trouble there, and as already indicated, if the calling apparatus works in good shape, and speech can neither be transmitted nor received, the cord is probably damaged.

Any man can readily test a suspected cord for himself, however. Disconnect it from the telephone and box. Hang up the telephone in its place. Now disconnect the line and ground wires from the main binding screws on the top of the bell box. Attach the two tips at one end of the cord to the line and ground terminals of the bell box, in place of the disconnected wires. Hold the two tips of the other end tightly together and ring the bell, at the same time pulling the cord, so as to hold apart any two points where a break may be. If the cord is all right there will be a continuous circuit, and the bell will ring. If the cord is broken it will not.

8. The subscriber's bell rings loudly when he sends a call, but he can get no response. One of two things: The line is badly grounded or crossed; or the annunciator is stiff at the joints and does not fall.

In the first place there is nothing to do but to locate and clear the ground, and in the second place notify the central office authorities to repair the drop.

If the central station finds no trouble in calling the subscriber, the latter trouble it is, which is doing the mischief. If the first named trouble be decided upon, and there is but one station on the line, after becoming satisfied that the ground is not within the limits of either central or subscriber's station—which is readily done by opening the line at the point where it leaves either office, and noting that if all is right at these points, no current will pass—there is only one thing to do, and that is to go over the line until the ground is found and removed.

If there be several stations, the matter is simplified materially, as it can then be localized between two stations, by visiting the subscriber's stations one after another. If one is found where "central" cannot be raised, and at the next station in the direction of the central office, the said office can be raised, it is only necessary to go over the intervening section.

9. The bell rings frequently, but in a feeble and irresolute and chattering way, and without any good reason.

The line is evidently crossed with a Morse or printing telegraph line, and must be cleared.

10. Suppose a subscriber has two bells on different lines, one of which may be an exchange line, and the other a private line, or both private lines, and both repeatedly ring at the same time.

The two lines are certainly crossed. The proper thing to do before hunting the cross is to sit down and think out the different sections of line where they run together, and then to go out and examine such sections until the cross is found; or else—and this is a mighty significant "or else"—the two lines coming to the same ground terminal, are not provided with a good ground connection, and consequently when a call comes in on either line, instead of the call currents passing entirely to earth, a portion leaks over to the other line. To find out whether this be the case open the second line where it enters the window, and ground it there. Then ring over the other; if the fault indeed be a defective ground connection the ring will again come on both bells. If the fault be a cross outside it will now only come on one bell. In the former case examine and improve the ground terminal until the fault disappears.

(*To be continued.*)

The committee on streets and alleys of the Chicago city council has presented a report adverse to the petition of the Lake Street elevated road. It was discovered that the necessary frontage had not been signed in any single mile. It appears that the railroad company in making its calculations counted the frontage of the alleys crossed and also the street intersections, and, deducting these, which belong to the city, the petition is short in each mile the number of feet represented by the streets and alleys referred to. The company may be able to supply the deficiency, but until it has been done, and the petition has been signed by a majority of the frontage in each mile, the ordinance cannot be legally passed.

Successful Underground Arc Light Circuits.

To the Editor of the WESTERN ELECTRICIAN:

CHICAGO, June 30.—In a recent issue of an eastern electrical paper, under the head of "Those Damp Conduits," is published an interview with Prof. Henry Morton, of Stevens Institute, wherein he gives certain reasons why underground wires for arc circuits cannot be successfully operated.

There is no subject upon which a man can feel more at liberty to express his views without risking contradiction than this one of underground wires, and in this case we would feel inclined to believe what the professor says, without questioning the accuracy, were it not for the wide discrepancy that exists between what he says is true and what we have found to be true. He says a moist conduit is utterly useless for carrying arc, and in some instances incandescent currents, because there is no known insulation that will stand the effects of the moisture on the one hand and the tendency of the current to break through to the earth on the other. Further on he says that no satisfactory material has been found for the protection of insulation on underground wires. This is a severe arraignment of the several manufacturers of underground cables for arc currents, and no doubt those gentlemen can convince the professor that his statement is a trifle broad and considerably lacking in accuracy.

We are working through fifty miles or more of lead cable in Chicago, all underground, and in a wet conduit, and are furnishing a satisfactory light service for 1,000 lamps. The lead cables contain an insulation six thirty-seconds of an inch thick, and, while the cables of this type have been in service only about four months, we have so far not had one case of trouble in them. It is true that the lead cables put in in November and December last were burned out almost immediately upon being put into service, but this was not because the insulation was not suitably protected from the moisture of the conduit, but was entirely owing to the fact that the insulation of three thirty-seconds of an inch was too thin. These cables had not been in service long enough to be impaired in the slightest by either gas or moisture, nor have the cables in use at present. It will no doubt take a long time to determine what the effect will be of the moisture and gas on the lead protection to the insulation, but we see no reason why there should be any, because of the fact that lead-covered telegraph and telephone cables have been lying in the same conduits for four years and are in a good state of preservation.

The professor says, in support of his position, that in Philadelphia a mile or two of arc light wire was put underground but soon had to be abandoned. As he fails to furnish any particulars, it may be that he alludes to the circuit that we were told about at the Pittsburgh convention, which was not constructed according to the best ideas of underground work, and for the failure of which there were good reasons.

D. R. Walker, chief of the electrical department of Philadelphia, says under date of February, 1888: "The Brush company have been using underground cables on a sixty-light circuit since the fall of 1885, the current passing through the cable twenty-two hours a day, and the daily test sheets show no deterioration." Evidently Prof. Morton and Chief Walker are not in close communication on this subject, or else the latter has had some reverses in his underground experiences. Nor does the professor remember that Mr. Wilbur, of Girard college, has had an underground circuit of two miles, carrying forty-seven lights, in operation for a year without any trouble.

To the statement made by the professor that it is only possible to run electric light wires underground for a short distance (this term may be taken to mean 1,000 feet) I would say that some of the Chicago circuits contain between three and four miles of wire, and there is practically no difference in the service furnished on the long and short circuits.

The professor says that arc light wires would last for some time underground if provided with about *nine inches* of lead around the insulation. The lead around the Chicago cables is one-eighth of an inch thick, and the diameter of the entire cable is about three-fourths of an inch.

Regarding the cause of the destruction of the lead cables that were used here in the early part of this year we have no explanation that we can put forth with any degree of certainty. Many theories have been advanced, and among them are two that are worthy of consideration. The first is that when the dynamic current of 2,300 volts passes through the copper conductor it generates static electricity in the lead covering around the insulation. Under ordinary circumstances the conduit, which is made of Dorsett material, is a good insulator, so that the lead is not connected with earth. When the lead becomes fully charged the theory is that it discharges back into the copper conductor, puncturing the insulation at the point where the discharge occurs. Now a burn-out need not occur at the time of the puncturing, because the lead has no connection with the earth, and if the circuit is, aside from the puncture, in good shape, there is nothing to provoke a burn-out. When, however, the conditions in the conduit change so that the lead becomes grounded by moisture in the ducts, or in the water in the man holes, a burn-out takes place at the point where the insulation was punctured. The second theory is that the belts on the dynamos generate a great quantity of static electricity, which finding no outlet to earth in the dynamo room is carried into the dynamos and out upon the circuits, where at some point in the lead cable it punctures the insulation and escapes to earth. Every one familiar with the jumping propensities of static electricity will understand how this theory can be applied to the occurrences cited.

As has been stated, the "burn-outs" have all occurred in the cables of thin insulation (three thirty-seconds of an inch), while none have taken place in the larger ones (six thirty-seconds). Accepting either one of the theories as correct, the exemption from trouble in the cables now in use can be credited to the thick insulation entirely.

While we do not take the position that we have solved the problem of working arc wires successfully underground, we do assume the position that it can be done, and that leaving out all of the instances of failure that were caused by construction palpably bad, there is more proof that it can be done than there is that it cannot be done.

It cannot be denied that the proper place for a large number of arc light wires is underground, and that there is justice and reason in the complaints of the New York press against the condition of affairs in that great city. The numberless poles and the labyrinth of wires in the narrow and crowded streets, coupled with the semi-occasional report of some one severely injured, if not killed, make in themselves a commentary on the electrical genius of the chief city in the country that ought to be humiliating for any man or set of men to hear. The permanency and popularity of the service demand that it be carried on without imperiling the safety or convenience of any one, and the attitude that seems to have been assumed in New York that no change can be made on present methods is not calculated to help the service in either respect.

We are sorry for the encouragement that Prof. Morton gives to the anti-underground wire men, for the reason that the data to be had does not justify him in doing so, and because, though it be accurate or inaccurate, such a statement from such a source may help to put off the day when improvements ought to be made that are imperative, not only for the general good but for the good of the arc light service.

B. E. SUNNY, President,
Chicago Arc Light & Power Co.

CORRESPONDENCE

New York Notes.

NEW YORK, June 30.—The meeting of the American Institute of Electrical Engineers, June 19, was one of great interest, and fully attended. The subject: "The solution of the municipal rapid transit problem," was very elaborately treated by Frank J. Sprague, a member of the institute, who, as is well known, has given the matter not only very thorough study, but has been able to carry out both experimentally and practically the application of electricity to the operation of railroads. While touching upon all branches of this intricate problem, Mr. Sprague based his paper on the extensive and successful installation of his system at Richmond, Va., and every person interested in the advance of electrical science should feel gratified that he has been able to overcome the serious obstacles encountered in the work. The new lantern presented to the Institute by President Weston was brought into use for the first time, and the numerous views prepared for the occasion added materially to the proper appreciation of the importance of the results attained, as an indication of what may be reasonably hoped for in the future development of electric railways. The length of the paper together with the exhibition of the views, precluded a general discussion which was thought proper to defer until the next meeting of the institute.

Judge Andrews of the Supreme court has issued an injunction upon the application of the Commercial Telegram company restraining the Stock exchange from making a contract giving exclusive rights to the Gold and Stock Telegraph company, or any other corporation to the exclusion of the Commercial company. It also enjoins the authorities of the exchange from interfering with the floor privileges of the latter company. The injunction was the outcome of the suit which has been pending for several years regarding these privileges. It was once decided in favor of the exchange, but upon appeal the decision was reversed.

The work of removing dead wires from the streets of the city appears to be occupying the attention of the Board of Electrical Control at present. It is, of course, true that the existence of these wires have added much to the alleged dangers inherent to the suspension of electrical conductors, and while their removal will involve considerable expense the various companies continue to express their satisfaction with this particular work of the board.

It is to be regretted that the fright to which Mrs. Pfeifer was subjected on the Jamaica Electric Railway during a thunder storm should be made the subject of controversy between representatives of rival systems, claiming that there may be danger in using a particular kind of motor while there will be none if the low tension current is used. While this may or may not be true, the public knows no distinction, but they are all classed as electric; and therefore the newspapers call them dangerous. Lightning is liable to strike almost anywhere, and no system having conducting wires can expect to be entirely exempt from the liability of receiving an occasional visitation. Even the streets of this city are liable to be invaded by lightning, and the danger will be somewhat increased by the final burial of the electric conductors, which have no doubt served to dissipate the atmospheric electricity during the serious thunder storms which sometimes pass this way. Such a storm on Tuesday created considerable excitement on Twenty-fifth street, where a spherical body of dazzling brilliancy appeared and struck in a pile of gravel and other building material, boring a hole through a brick and another through a plank, according to the statements of the usual eye-witnesses. Whether the commotion was caused by lightning or a meteor has not yet been reported.

An attempt is being made by the Board of Electrical Control, through the district attorney's office to have some of the electrical companies indicted for failing to take down their poles and wires as required by law. The proposition was not received with any great degree of enthusiasm, and it appears probable that any attempt to enforce the law in that matter will lead to endless litigation.

After considerable delay, the Schuyler Electric Light company of Elizabeth, N. J., started up its incandescent lighting from central station on Saturday night. Only about one hundred lamps have as yet been placed, but the number will be rapidly increased as they give general satisfaction. The Westinghouse converter system is used.

Edward Weston is very much pleased with the operation of a gas engine with which he is driving the machinery of his laboratory at Newark during the summer months. It requires very little attention, and he finds it more economical for his use than a steam engine generating the same amount of power.

After devoting about a month to the rumored electric light corruption in Brooklyn, the grand jury reported on Friday that "after an extended investigation they fail to find evidence of corruption on the part of any person or persons seeking a franchise from the city for the purpose of lighting the city with electricity, or furnishing the same for private consumers."

Among the abandoned copper mines which have been galvanized into life by the prevailing high price of copper is one located at Bristol, Conn., which is being developed by a party of capitalists from Pittsfield, Mass. Very favorable reports have been made to them as to the quality of the ore, and if the present price of the metal is maintained they expect to make a profitable business of it.

The report that the European copper syndicate has purchased the three years, output of two of the leading mines in Japan has been confirmed. The mines in question are the oldest in Japan. The amount of copper from them heretofore sent to England has rarely exceeded 1,000 tons per annum, and the surplus beyond home consumption has been shipped to China and India. When the price began to rise last fall, however, some enterprising merchants gathered up all the old copper they could find in China, amounting to about 1,000 tons, consisting of old saucers, lamps, idols and other bric-a-brac. This, of course, attracted attention to the east as a source of supply, and compelled the syndicate to secure the surplus output of the principal mines in order to protect their European and American markets. The amount they will have to take in order to accomplish this is estimated at about 8,000 tons yearly.

Prof. William A. Anthony, consulting electrician of the Mather Electric company, read a paper on overhead wires before the Electric club Thursday evening, in which he took strong ground against the attempt to enforce upon the electric lighting companies the use of underground conductors. Among many others who were present and took part in the discussion were Prof. William D. Marks and A. J. De Camp of Philadelphia, C. J. H. Woodbury of Boston, Schuyler S. Wheeler, H. L. Storke and Nikola Tesla of New York City. P.

Helena, M. T.

HELENA, M. T., June 27.—The electric light company's plant was destroyed by fire a short time ago, but with characteristic energy the directors immediately began to form plans for rebuilding the plant. The new building will be 54x120 feet, with one story and a basement. The dynamo room contains five arc light machines, with a total capacity of 150 arc lights, of from 1,200 to 2,000 candle power each; four continuous current machines with a total capacity of over 2,000 sixteen candle power lights; two alternating current dynamos with a total capacity of 1,000 sixteen candle power lights. The engine room will contain three 150-horse power Corliss engines. The boiler room is designed to accommodate six tubular boilers, in three batteries. The coal bunks will also be under this roof and will have a total capacity of 100 tons, thereby providing against any possible interruption of operations in consequence of a short fuel supply. This end of the building will be so located that fuel can be taken from the railroad cars immediately into coal bins. Beneath the machine room, hallway and offices will be a basement 54x90 feet, which is intended partly for storing supplies, but mainly for storage batteries. The alternating machines and storage batteries will be entirely new features in the electric lighting business here. The storage batteries, in addition to forming an available source of supply in case of accident to machinery, are intended to be used for furnishing motive power, and it is not improbable that before the close of the present year motors will be employed for running elevators, wood-work-

ing machinery, printing machinery, sewing machines, dental and jewelers' lathes, coffee mills, and ice cream and soda water machines. When the company's new station is fully equipped, it will have ample power and machinery, in addition to supplying all the light required by consumers, to afford motive power to street car lines. The plans as adopted by the company contemplate a plant which will be sufficiently large to supply every possible demand for the present and well into the future, while the appointments are all selected with a view to giving the most satisfactory light and power at rates consistent with good service. The company has appointed William Harrison, business manager, as already announced in the WESTERN ELECTRICIAN, who is now pushing the primary arrangements to completion, and promises to have work begun on the new buildings inside the next ten days. With the Gas company's enlarged plant, the Home Electric Light company's practically new plant, three times or more the capacity of its old plant, and the new Electric Light company's proposed works, Helena may very reasonably look for superior light and plenty of it, at rates which ought to be satisfactory to the consumers at least. McD.

Kansas City Notes.

KANSAS CITY, MO., June 1.—Many of the business men of the city who are telephone subscribers, have during the past few weeks requested Mayor Kumpf to take some action in regard to having an ordinance passed requiring the telephone company to reduce its rates. They think $50 a year is enough to pay for telephone service within the city limits. The success which the St. Louis council is meeting in its endeavors to have the telephone rates reduced in that city, has prompted the movement here. The mayor has finally consented to make a move in the matter. He has requested M. R. H. Quarles, the city counselor, to look into the matter. He says he wants to know what the law on the subject is before any action is taken. He is of opinion that the telephone rates need revising, but considers the matter a very important one, and that it is best to go slow in it.

One of the business men who called on the mayor made this kind of an argument: "There is a big monopoly in the telephone service in this city. I pay $9 a month, or $108 a year, for a telephone in my house; there are 2,500 telephones in use in this city. At an average of $100 a year for each subscriber, the revenue to the company is about $250,000. It is safe to say that the expenses are not over $100,000 at the greatest. The maximum rate for each telephone should be not over $50 a year."

Superintendent W. W. Smith, of the telephone company, views the movement with great calmness. If he is at all affrighted his bland and smiling countenance conceals his real feelings most successfully. "We would not attempt to carry on business," he said, "if we could not charge at least our present rates, and they are $72 a year for each telephone within three-quarters of a mile of the central office, and $6 additional for each additional quarter of a mile. I don't know whether an ordinance fixing the rate of any certain amount not suitable to us would be legal if passed by the council. We would probably test the matter in the courts, and were we defeated, we would abandon our system where it is. Of course that is on the supposition that the rate would be made lower than at present. But before such steps are taken as are proposed, the telephone system should be investigated, and our books will be open for examination. The public has mistaken ideas about the telephone business. It cannot understand why our expenses are not smaller than they are, and our profits larger. We have to pay royalties on every little instrument used. We have now nearly 2,500 telephones in operation, but have boards equipped for 3,000. There are required to run these boards, 4,500 jacks, small brass ferrules, costing fifty cents each. For 4,000 telephones [illegible] jacks would be needed. That is only an iota of the [illegible]e. For each subscriber we pay a royalty of $100. [illegible]ne, of more or less size are also paid on many other [illegible] connected with the telephone. To prepare a [illegible]ard for 300 instruments, the services of four or five men [illegible] month are required in the office. For every seventy-[illegible] subscriber here an operator is required. Wires wear [illegible] and we are putting in cables costing sixty cents a foot. We will soon have to have new quarters, and it would cost [illegible] $30,000 to move across the street. In order to make [illegible] the best possible, we have all our wires run [illegible] our room, which greatly increases the expense, for, to [illegible] the wires for 10,000 subscribers in one room, would [illegible] $150,000 more than to put the wires for 5,000 subscribers in each of two rooms. The first year this company [illegible] a dividend of 8 per cent was declared, [illegible] granted for the next three years. The [illegible] to receiving a dividend of 6 per cent. Our [illegible] somewhat different from that of the St. Louis company. While both are operating under a state law, the St. Louis company accepted an ordinance a few years ago regulating the erection of poles, which gave the council the right to fix the telephone rates. The St. Louis case has now reached the courts and will be settled by the Supreme court in October. If the telephone company is beaten it will take out its telephones, for it cannot operate if its rates are cut down from $100 to $50 a year."

James Powers, an employe of the Kansas City Electric Light company, was seriously injured last week. Powers climbed a ladder for the purpose of trimming a light. Upon grasping the burner a charge of electricity passed into his body, and he found himself unable to release his hold on the burner, but he jumped from the ladder, falling to the ground. When picked up he was unconscious, but revived after being taken home. A badly burned hand and severe nervous shock were the results. A defective cut-off was the cause.

The Southwestern Electric Supply company has moved into uptown offices in the National Bank of Kansas City building. The company now represents the Baxter Motor for the west, and is selling many of them. The electric goods of Patrick & Carter—annunciators, bell, alarms, etc.,—are also being handled by the company now.

W. H. McKinlock, of the Central Electric company, of Chicago, and Willard L. Candee, of the Okonite company, New York, were in the city, last week, for a brief time, but left on a "still hunt."

The Kansas City agency of the Thomson-Houston company, has secured the contract for furnishing the electrical equipment of the Suburban & Riverside Railway, of Wichita, Kas. The line will be six miles long when completed. The Thomson-Houston company is to furnish six cars, six motors, two 50 horse power electric generators, and all other electrical appliances and fixtures necessary. The system of transmission will be that of the single overhead conductor, and the contract involves about $60,000. The same agency has also secured the contract for furnishing the Pine Bluff Ark. Water Supply company with seventy arc lights and 1,000 incandescent lamps.

The Loomis Electric company of Boston, is now represented here, its agent, Mr. Cutter, arriving last week.

Charles Grover, the general southwestern agent of the Hawkeye Electric company, of Oskaloosa, Ia., whose headquarters are in this city, is now filling a contract obtained from the Hutchinson Kan. Water, Light, Power and Telephone company of one 10 horse power, one 5-horse power, two 1 horse power and two ½ horse power motors. For the Horton Kas. Electric Light and Power company Mr. Grover is putting in twenty-five arc lamps and 300 incandescents. The Hawkeye is also putting in motors at Missouri Valley, Ia., where Paul W. Bossart, of the Inter-State Electric company of this city, is putting in a central station of the accumulator system. Two motors will be supplied, each of 3-horse power.

C. H Cone, of the Electric Supply company, is keeping himself on the jump at present. Last week he was visiting various points in Iowa and Northern Missouri. This week he is overhauling the towns in Western Colorado and New Mexico.

Mr. Steele, representing the Brush, of Cleveland, has secured the contract for a twenty-five arc light plant at Washington Park.

The dealers and agencies generally report business dull in their line in the west at present. Two reasons are given for this condition of affairs, either of which alone is sufficient to cause a considerable falling off in trade, and when both are present the result is particularly doleful. One is that the people are slow in realizing that now is the best time to order electric lights, as the long evenings render their use at present of no great necessity. They forget that it takes time to put in an electric light system, and that if they wait until short days and long nights create a boom for illuminators, the long days and short nights will almost come around again before an electric light system ordered in the fall can be gotten into operation. The other cause is the scarcity of money. Money has grown exceedingly scarce in the west during the past three months. But the crop prospects are unusually favorable and everybody is taking heart and anticipating prosperity in accordance therewith.

The city council is beginning to realize that the fire department is inadequate for the city, and that the greatest need at present is a first-class fire alarm system. The city has been depending upon the telephone for fire alarms, but the instruments are so scarce in the city that the telephone is not to be relied upon for quick service. It is probable that bids for furnishing a fire alarm system will be advertised for at an early date. A.

Topeka, Kan.

TOPEKA, KAN., June 30.—Not long ago the city contracted with the Jenney Electric company of Indianapolis for an electric light plant. The contract calls for a plant of a capacity of 120 arc lights of 2,000 candle power each. The Third ward of this city was dissatisfied with the number of lights assigned to it by the council out of the 120 arc lights so be supplied by the city's plant when the Jenney company got it in and remonstrated with the council. Their remonstrances being of no avail the citizens of the ward then instituted legal proceedings to restrain the city from opening its Jenney plant and secured a temporary restraining order. The city council naturally was startled by this action and resolved to do something to appease the wrath of these neglected citizens. Accordingly a special meeting was held last week, and a resolution was adopted declaring a large portion of the city now without light, that additional light was absolutely necessary, and directing the city engineer to prepare plans and specifications and a detailed estimate of the cost of sixty additional improved Indianapolis Jenney electric lights and for the machinery and appliances necessary to operate the same.

The engineer has now prepared plans for a sixty 2,000 candle arc power light plant and has estimated the cost at $17,500. It is now thought that the injunction proceeding will be withdrawn. B.

Missouri Towns

SPRINGFIELD, MO., June 30.—General Manager Keyser of the electric motor line has returned from Detroit, will take up his permanent residence here and will give personal attention to conducting the lines of the company. The steel for the tracks is being manufactured at the rate of fifteen tons every fortnight and is shipped here in installments. The ties are ready for the miles of track and grading has commenced. The engines and rolling stock are being constructed as well as the dynamos and boilers for the power house. Mr. Keyser is confident that the first three or four miles of the road will be in operation by August 15th.

BOONVILLE, MO., June 30.—The latest movement in the electric-gas fight in this city is the appointment of a committee by the council to investigate the gas company's suit to enjoin the electric light company and to bring suit against the gas company for the forfeiture of its charter.

LEBANON, MO., June 30.—The Lebanon Magnetic Water company with a capital stock of $10,000 has been incorporated. The directors are Isaac Haskinson, M. P. Nixon and four others. The company has a tank constructed to hold 240 gallons and a bath house of four tubs. A peculiarity of the water is that although the well is 1,000 feet deep the temperature of the water is between 61 and 62 degrees or about .5 degree warmer than water in the ordinary wells and cisterns.

CARONDELET, MO., June 30.—An electro plating establishment will soon be in operation here. The company has one dynamo of twenty horse power and one of four horse power. It will make a specialty of copper plating.

LEXINGTON, MO., June 30.—E. W. Abendroth, of this city, has submitted a proposition to the city council for the establishment of an electric light plant here, the motive power to be furnished by the water works company.

WASHINGTON, MO., June 30.—The Bell Telephone company is constructing a line from St. Louis to this city. A public and a private wire are being strung. The company is negotiating for the purchase of a private line from this city to Union. D.

The Rockies, Eastern Slope.

TRINIDAD, COL., June 27.—The Trinidad Electric Light company now has its plant in operation, the current having been turned on the city circuit last week. A sort of informal jubilee on the part of the citizens was held.

OMAHA, NEB., June 30.—The Interstate Fire Alarm company has been incorporated, with a capital stock of $50,000, by F. B. Johnson and others. The company will manufacture electric fire alarm apparatus of the kind that has been manufactured hitherto on a small scale at Columbus, O.

Four masts are being erected in the high school grounds for the 2,000 candle power arc lights with which the grounds will be illuminated as soon as the plant is put in.

KEARNEY, NEB., June 29.—J. G. White, president of the Western Engineering company of Lincoln, Neb., is here with a view of putting in Sprague electric motors for the Kearney Canal and Water Supply company. He has secured the contract for furnishing two electric motors, one of twenty and the other of thirty horse power, for the pressed brick and terra cotta works.

DES MOINES, IA., June 30.—H. E. Teachout has just returned from an extended trip east in the interest of the Des Moines Broad Gauge Street railroad, and his errand was the investigation of the question of the operation of street railways by electricity. He examined the roads in operation in Lima and Mansfield, O; Binghamton, N. Y.; Scranton and Wilkesbarre, Pa.; Richmond, Va., and Philadelphia. His trip has made him a greater believer than ever in the

electric railway, and the company he represents will go right ahead with the construction of their line. The Sprague company and the Thomson-Houston company have made propositions for the construction and equipment of the road, and the outside figures reach nearly $40,000. It is expected that the road will be in operation by September 1st. E.

Indianapolis Items.

INDIANAPOLIS, IND., June 30.—The two telegraph companies here delivered something like 2,000 congratulatory messages to General Harrison, the nominee of the Republican National Convention for president, in the thirty-six hours after the nomination was made.

The Indianapolis Jenney Electric company furnished and put a dynamo and about a dozen arc lamps in General Harrison's grounds for use during the week.

The Indianapolis District Messenger company has organized a system of police patrol and is putting up a large number of signal boxes through the main business part of the city.

The Bell Telephone company, in turning in a list of their taxable property in this county, put their instruments in at $3.60 each. The board of equalizers raised the valuation to $5, claiming as the company get a rental of $14 each yearly for the instruments their valuation is too low. The telephone company have employed an attorney to look after their interests in the case. M.

From Detroit, Mich.

DETROIT, MICH., JUNE 30.—A new yacht now being fitted out at the Wyandotte ship yards for M. S. Smith, of this city, will be equipped with a 30 A light plant by the Electrical Accumulator and Lighting company. Seventeen accumulators of the 23 C type will be put in. The company report a constantly increasing demand for accumulator plants. Some 2,000 lights are in use in Detroit, and several large orders are in the course of completion. A 400 A light plant in the city hall has entirely displaced the gas service.

The Michigan Railroad Consolidation board has approved the consolidation of the Minneapolis, Sault Ste. Marie and Atlantic Railway company, the Minneapolis and Pacific Railway company, and the Aberdeen, Bismarck and Northwestern Railway company under one management, making a continuous line of about 1,000 miles, extending from Sault Ste. Marie, Mich., to Bismarck, Dak. C.

Kansas Towns.

MARION, KAS., June 30.—This city is now without telephone service, the agent of the Bell company having come, seen and conquered, confiscated the eighty infringing telephones of the Electric company and burned them in the street.

LAWRENCE, KAS., June 29.—Mr. Kirts, of Cleveland, O., mechanical engineer, is in the city locating machinery and shafting for the new electric light plant of the gas company. Two systems will be used by this company, the Thomson-Houston arc and the Westinghouse alternating incandescent.

HORTON, KAS., June 28.—The Horton Electric Light company is now putting up the poles and wires, and if nothing unforseen occurs the plant will begin operations July 4.

HIAWATHA, KAS., June 28.—The Hiawatha electric light company now has its plant in operation and it is proving a great success. C.

The Rockies' Western Slope.

LOS ANGELES, CAL., June 26.—The Los Angeles Cable Railway company has made an assignment to W. R. Blackburn. The road has been operated by electric motors.

SAN PEDRO, CAL., June 27.—The Pacific Mutual or the Postal Telegraph will extend its western line to this city this summer.

SAN JOSE, CAL., June 27.—The new electric railway is now in successful operation. F.

The Southwest.

EL PASO, TEX., June 28.—The fire department is now arranging with the telephone company for a telephone-fire alarm system. The city will be divided into twenty districts, and where the telephones are not numerous enough new ones will be put in for the fire department.

GAINESVILLE, TEX., June 28.—Mrs. Henry S. Dye was struck on the top of the head by lightning, which ran down her left side, unbuttoned and removed her shoe and left her unconscious. It is thought she will recover.

FORT SMITH, ARK., June 29.—A large number of Pan electric telephones will be put up throughout the city during July. G.

THE ELECTRIC LIGHT.

Lightning recently ruined a dynamo in the plant of the Lowell, Mass., Electric Light works.

The Tyler Electric Light company of Tyler, Tex., has been organized, with $50,000 capital stock.

The Zanesville, O., Edison Electric Light & Power company has been incorporated, with $60,000 capital stock.

The Hicks Induction Light & Motor company has been incorporated at Detroit, Mich., with capital stock of $400,000.

The Thomson-Houston company of Chicago has sold a plant of fifty arc lights to the Seattle, W. T., Electric Light company.

The Delavan Electric Light company, of Delavan, Ill., has been incorporated with a capital stock of $6,000. The incorporators are J. M. Allen, A. L. Maclay and F. E. Allen.

The Edison Electric Light company of New York has again applied to the common council for a franchise. The company has already received permission from the electrical subway commission to lay underground conduits.

The Fresno, Cal., trustees have granted an electric light franchise to A. H. Emery. There is a provision that requires the company to take down its wires within thirty days and put them under ground if the city council demands it.

The Eau Claire, Wis., Brush Electric Light company has already increased its order from 800 or 1,000 incandescent lights of the Fort Wayne Jenney alternating system mentioned last week to 2,400 lights, of which 1,600 will be put in at once.

A number of the managers of theaters in Madrid will be unable to install lights by September 1, the date on which all places of amusement must be lighted by the better illuminant in accordance with the royal decree. A petition for an extension of time will be presented to the government.

In St. Louis last week a horse was killed by a shock from an electric light wire which had broken loose from its fastening. The wire hung across St. Charles street. The driver of the horse happened to pull up the animal just before the wire was reached. The animal opened its mouth and the wire struck the bit. The horse was killed instantly.

Gas exploded in an electric light conduit at the corner of La Salle and Washington streets, Chicago, last week, blowing the manhole cover several feet in the air. The gas pipes near the intersection of those streets leak continually and for some reason the gas seems to collect in the conduit. Just where the spark which caused the explosion came from, seems to be a mystery.

E. Blass, a German scientist, has used an incandescent lamp for actual inspection of the inside of boilers under steam. A thick glass tube was introduced through a stuffing box, a small incandescent lamp was lowered into this and lighted by means of a small battery. By this means the whole of the boiler was lighted up, and could be inspected through a thick glass plate inserted in the boiler.

June 9, during a heavy storm at Portland, Ore., lightning struck the wires of the local electric light company, and, following them into the station, burned out the armatures of three dynamos, and consequently extinguished all the arc lights in the city. Only one circuit of incandescent street lamps remained lighted. The burning of the safety strips saved the machines. The damage to the company is about $1,000.

The electric subway commissioners of New York have asked the district attorney to get the grand jury to indict the telephone, telegraph and electric lighting companies whose wires are above ground, that the suspended wires are a constant menance to pedestrians. Affidavits are also to be sent to Corporation Counsel Beekman setting forth that the subway is now in a condition to receive all the electric lighting companies' wires.

Louis Lubin of New York, is quoted as saying: "Quite a number of experiments were made with a death-dealing electric current before the present law to execute criminals by electricity was submitted to the state. I have seen a young and vigorous bull, which certainly had as much vitality as the average American murderer, killed so quickly that there was but one wild flutter of the pulse recorded on a sphygmograph, between a condition of health and palpable unconsciousness, coma and death. No scientific man believes that electricity gives a painful death; the shock is so sudden and so strong that one hasn't time to feel. It is a death to be preferred to any other which human beings can die. It is euthanasia perfected. The men who are accidentally shocked by dangerous amounts of electricity suffer when recovering, not when they are struck down."

Prof. Blyth recently read before the Glasgow Philosophical society a paper in which he described an experiment which he made last summer—the lighting of a cottage in which he spent his vacation by a dynamo driven by a windmill, and charging a storage battery. The windmill used was an old-fashioned type, with four arms at right angles to each other, each of them thirteen feet long. There was no especial regulating device. The dynamo was belted directly to the fly wheel of the mill, and charged twelve cells of storage battery, which supplied the incandescent lamps in the cottage. Prof. Blyth has never used more than ten lamps at once, but he could have used more. With a good breeze, enough electricity could be stored in half a day to supply light for four evenings of three or four hours each. The lamps used were of eight candle power. When charging, the current passed through a cut-out that would disconnect them from the dynamo when it ran below a certain speed; so the windmill could be allowed to run all the time, charging the battery when the wind happened to be strong enough. The current had been used to run a light turning lathe, and Prof. Blyth had begun to make a light carriage to be run by the stored electricity.

THE ELECTRIC MOTOR.

The Portland & Vancouver Railroad company will establish a telephone line between Portland and Vancouver.

The telephone company of Valparaiso, Ind., is removing its poles from the streets in accordance with a recent resolution of the city council.

A company with a capital stock of $20,000 has been organized at Columbus, Ind., for the purpose of building an electric street railway. The company embraces a large number of the citizens.

President Cleveland has allowed the act to authorize the Paris, Choctaw and Little Rock Railway company to construct and operate railway, telegraph, and telephone lines through the Indian Territory, to become a law without his approval.

A contract has been taken by the Sprague company for the East Side Railway of Brockton, Mass. The first equipment will consist of six cars with about five miles of trackage. This is the road which was incorrectly reported as having made a contract with the Thomson-Houston company.

The Sprague company have just received an order for the equipment of forty new cars on the old line in Richmond, Va.; the order to be completed by the first of October. This makes the total Richmond equipment of 80 cars, and about 27 miles of track, and it is expected that the number of cars will be increased to over 100 in the near future. The number of passengers carried daily averages about 13,000.

The New York papers a short time ago contained stories concerning an electric shock which Mrs. Lizzie Pfeifer sustained, while riding on the electric road from East New York to Jamaica. A gentleman who investigated the case made this report: "The electrical circuit from the power station consists of two bare copper wires directly over the tracks, supported by cross wires from ordinary telegraph poles on the sides of the street. These copper wires are connected directly with the dynamo at the power station, and are about fifteen feet above the surface of the street. Two flexible insulated wires run from the motor on each car to two wheels or trolleys resting on the overhead conductors. As the car moves, the trolleys are drawn after it, keeping the motor in constant connection with the dynamo. The current comes from the dynamo through the positive conductor or overhead wire, passes from the trolley down through the motor, up to the other trolley and back through the negative conductor to the dynamo. It is evident that to receive a shock one must be in contact, either direct or through wires, with both overhead conductors at the same time. It is absolutely impossible to receive a shock unless this condition be fulfilled. The motor is on the front of the car, inclosed in a cab, and separated from the rest of the car by a partition. A person sitting in the body of the car could in no conceivable way come in contact with the two overhead wires, and of course could not receive an electric shock. A person in the motor cab might touch the two bare ends of the wires running down from the trolleys, and so complete the circuit through his or her body, receiving a part or the whole of the current; but it is not alleged that Mrs. Pefifer was in the motor cab where passengers are not allowed. The trolleys on this road are poorly constructed, in consequence of which they sometimes fall from the wires. This is annoying to passengers but is simply a nuisance, not a source of danger. The fall of the trolley breaks the circuit and the current is cut off from the motor. No accidental shock can result under such circumstances. It is said that Mrs. Pfeifer was in a highly nervous condition resulting from a recent surgical operation. The trolley fell and she was greatly alarmed. On the repetition of the accident she fainted, and was carried from the car in an unconscious condition. She was attended for two hours by one of the employes, who gave me the foregoing information. I have no doubt as to the substantial accuracy of these facts, as the conditions made it impossible for her to receive an electric shock. To the ignorant electricity possesses many terrors, but it is subject to well defined laws, and a more general understanding of these laws would remove many unreasonable prejudices. The current used on the Jamaica road has a potential of 500 volts. Such a current would produce an unpleasant but by no means fatal shock. The precautions are such, however, that an accidental shock is almost impossible. The lesson conveyed by this accident is not that electric motors and their actuating currents are dangerous to life and limb, but that electric railways should be equipped with trolleys that would not fall off to the alarm of nervous passengers. Such trolleys are in use on many electric railways of all systems in this country."

THE TELEPHONE.

The Bell Telephone company has extended its successfu experiment of long distance telephony between Boston and New York to the establishment of a line between New York and Saratoga, beween which points it is competing with the Western Union for public business, says an exchange. The rates charged are rather steep as compared with the modest tolls of the telegraph company, but the compensating advantage to the customer lies in the fact that he can obtain a much quicker service and at the same time minimize the chances of his message falling into other hands than those of the person for whom it may be intended. But the supreme advantage of the telephone system is in there being no doubt or uncertainty of the conversation, or liabillity of error whatever. The telephone tariff ruling between Boston and New York is $2 for each five minutes or fraction of that time consumed in conversation, and the number of customers obtained and retained at that figure has encouraged the company to fix its rate between New York and Saratoga at $2.50 for the same time consumed though the distance is less than between the points first named. The discrimination in rates is undoubtedly due to the shortness of the Saratoga season, which is limited to about two months, in which time the company must be reimbursed for

the large and necessary outlay. Whether the Western Union will see fit to resent the encroachments of a rival which has heretofore been quite generally looked upon as an ally, or whether, indeed, in view of the recent successes of the telephone company, the elder corporation feels equal to the severe strain an open fight with such an adversary would entail, is a matter to be made plain to the public only by time. One thing is absolutely certain, however; that the Bell Telephone company is in the general telegraphic field with the intention of remaining there and if possible revolutionizing the business of telegraphy.

Personal.

E. R. Weeks, general manager of the Kansas City Electric Light company, on his way east, stopped in Chicago just long enough Saturday last to shake hands with a very few of his large number of friends in this city.

Business Mention.

Manufacturers of electrical apparatus who have tried tripoline, a polishing compound made by the Matchless Metal Polishing company of Chicago, unite in agreeing that it is a great labor saver and produces a most brilliant polish.

The Jenney Electric company, of Indianapolis, Ind., have been receiving numerous orders increasing the capacity of many of their California plants. The city of Topeka, Kan., has increased its original order 50 per cent. and Sullivan, Ind., has just sent in an order for a plant of 60 arc lights.

The Clark Electric company, of 159 Chambers street New York, have issued a catalogue devoted to their dynamo. The apparatus presents new features in many respects. The dynamo has made a record twenty lights with eleven and nine-tenths horse power which is something remarkable.

Electrical Patents.

Issued June 26, 1888.

384,958. Galvanic Battery. Charles A. Brown and Martin M. Clark, Chicago, Ill.

The invention consists, speaking generally, in substituting for the bricks a depolarizing mixture consisting of equal parts of peroxide of manganese and carbon, this mixture being contained in bags which are tied to opposite sides of the carbon element.

384,962. Electric Railway Signal. Stanley C. C. Currie, London, County of Middlesex, England.

385,001. Rheostat. James W. Packard, New York, N. Y.

We give the last claim: "5. A rheostat which has the following parts in combination: A skeleton frame which has suitable cross bars resting on divided portions of two of its opposite sides, but insulated therefrom; a set of resistance coils strung on said bars and connected in series; an electrical connection between one terminal of the exterior circuit and one end of the series of coils, and two socket pieces which are electrically connected to the other terminal of the exterior circuit and which fit over the projecting ends of any of the said cross bars."

385,020. Electric Light System. Bernard E. Sunny, Chicago, Ill.

385,022. Apparatus for Electric Welding. Elihu Thomson, Lynn, Mass.

The invention consists in the organization of clamps for holding the pieces to be welded.

The first and last claims are given: "1. In an electric welding apparatus, the combination, with a movable clamp, of mechanism controlled thereby to cut off the welding current at a predetermined point.

"11. In an electric welding apparatus, the combination of a movable clamp, mechanism controlled thereby for cutting off the welding current at a predetermined point, and means for varying the amount of current fed to the apparatus."

385,023. Electric Switch. Patrick J. Tracy, Racine, Wis.

Claim 4 follows: "The combination, with a moving contact terminal, of a cleaner or polisher located in the path of motion of the said terminal, the said cleaner being elastically supported."

385,028. Electrolyte for Galvanic Batteries. Bloomfield J. Wheelock, New York, N. Y.

Claim 1 follows: "The herein described composition of matter to be used in primary batteries, consisting of nitric acid, sulphuric acid, pure water, sal-ammoniac, bichromate of potash or bichromate of soda, and sulphate of iron."

385,034. Electromotive Railway. Granville T. Woods, Cincinnati, Ohio.

We give the last claim: "13. An electric railway having a conducting path such as described, combined with a side track or branch railway having a conducting path looped in the main outgoing conductor, an independent generator interposed in the outgoing side of said loop, and a double or 'two-way' switch."

385,039. Holder for Incandescent Lamps. William A. Carey, Malden, Mass.

385,041. Switch for Electrical Purposes. William A. Carey, Malden, Mass.

385,042. Mariner's Recording Compass. Henry A. Chase, Stoneham, Mass.

"Claim 1: The combination of a movable needle or pointer with a series of electric circuits having terminals in different positions within the range of movement of said needle or pointer, and a circuit controlling device movable with the said needle or pointer and having an independent movement affecting the said circuits, the circuit at any time affected thus indicating the position of the needle or pointer at that moment."

385,043. Electric Alarm Compass. Henry A. Chase, Newton, Mass.

"Claim 2: The combination of the pivoted needle of a mariner's compass with an electric circuit having terminals co-operating with the said needle, and a shield movable with relation to the compass box or supporting framework of the said needle, the said shield, when in line with the needle, preventing the latter from affecting the said circuit."

385,053. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

We give the last claim: "19. The combination of a car body having a motor operating platform at its forward end, an electrically propelled truck pivoted under said platform, a source of electrical supply, a motor circuit carried by the car and supplying current to the motor, and regulating means on or at the platform for controlling the flow of current to the motor of the electrically propelled truck."

385,054. Electric Railway. Rudolph M. Hunter. Philadelphia, Pa.

385,055. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

"Claim 1: The combination of an electrically propelled vehicle having two electric motors, a source of electric supply, and switches for coupling up the motors in series or multiple with the source of supply to vary the speed or power of the motors;"

385,067. Electric Cut-Out. Charles G. Perkins, Hartford, Conn.

385,068. Dynamo Electric Machinery. Anthony Reckenzaun, London, England.

We give the following claims: "1. In an electric motor or dynamo, a field core having its polar ends united to polar extensions by bolted connections, in combination with a rigid frame to hold said field cores and polar extensions rigidly in position to form the armature space.

"17. In an electric motor or dynamo, a field magnet core formed with ductile magnetizable polar extensions bolted to it in grooves at its polar ends.

"34. In a dynamo electric machine or motor, field magnet cores forming a continuous magnetic belt around the armature, having two diametrically opposite parts brought close to the surface of the armature to form poles and coils upon said parts which are intermediate to the pole parts, said magnetic belt being formed of parts linked together, in combination with non-magnetic frames forming standards secured to said magnetic linked belt core to hold it rigidly together."

385,095. Lightning Escape for Wire Fences. Allin Cockrell, Lamar, Mo.

385,097. Electric Railway. G. Herbert, Conduit, Philadelphia, Pa.

The object of the invention is to provide ready means of removing storage batteries and for coupling such batteries with the motor or signal circuit.

385,145. Method of Generating Electricity and Purifying Water. John E. Siebel, Chicago, Ill.

"Claim 1: The method of purifying water to abstract from it an inherent substance having a corroding effect on metal, which consists in filtering it through divided pieces of iron or steel and rendering the iron or steel electro-positive to the said inherent substance by connecting it with an electrode electro-negative to the said substance."

385,147. Galvanic Battery. E. Eugene Starr, Philadelphia, Pa.

The first, thirteenth and eighteenth claims are given: "1. The carbon electrode constituting the containing vessel of the cell and provided with a surrounding metal terminal ring, said ring being united to said electrode by fastening devices.

"13. In a preserving vessel or cup to receive the electrodes of a galvanic battery when not in action, a cushion to receive the jar of the entering electrode.

"18. The combination, in a galvanic battery, of the series of carbon containing vessels forming one series of the electrodes of the battery, the terminal rings thereof, and the circuit connections united at one end to said terminal rings and fitted with openings at the other ends thereof, through which the zinc electrodes are suspended in the battery liquid, thereby forming an electrical connection between the electrodes of the series of vessels or cells by simply inserting the zincs through said connections."

385,173. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.

"Claim 9: In a system of electrical distribution, the combination of the switches revolved by electro-magnets controlled from the station, the stop disks for said switches revolved by other magnets controlled from the station, unison stops for the switches, unison stops for the disks, releasing devices for the stop disk unisons operated by the switch magnets, and releasing devices for the switchunisons operated by the stop disk magnets."

385,180. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

"Claim: The method of propelling and controlling an electrically propelled vehicle supplied with motive power from secondary batteries carried by the vehicle, which consists in coupling up the cells of the battery or batteries in fixed relation, supplying the motor or motors propelling the vehicle with the full current of the battery, and varying the speed and power of the motor or motors by coupling up the coils of the motor or motors in different relations to vary their internal resistance."

385,200. Secondary Battery. Anthony Reckenzaun, London, England.

"Claim 4: A cylinder or section of active material for an electroid, consisting of an elongated mass of oxide of lead or equivalent active material compacted into a solid smooth surfaced cylinder or section by pressure."

385,205. Test System for Multiple Switch-Boards. Charles E. Scribner, Chicago, Ill.

The invention consists in providing a polarized annunciator of high resistance in the circuit of each line after it has passed through its spring-jacks, and means for momentarily shutting any one of these polarized annunciators out of circuit when the test is made at the line.

385,211. Electrical Pumping Apparatus. Frank J. Sprague, New York, N. Y.

We give the last claim: "10. The combination of a separable motor and pump and a spring connection between their shafts."

385,214. Telegraph Relay. Frederick Stitzel and Charles Weinedel, Louisville, Ky.

"Claim 1: In a relay, the combination, with an electro-magnet and a pivoted lever, of a series of yielding abutments arranged in the path of said lever and adapted to be engaged in regular order."

385,215. Electrical Connector. Frederick Stitzel and Charles Weinedel, Louisville, Ky.

"Claim 2. In an electrical connector, the combination, with two sections of a railroad rail, each of which is provided with a tapering opening, of the collars shaped externally to closely fit within said openings and a wire the ends of which are secured within openings formed in said collars."

385,254. Battery Zinc. John Doyle, Hoboken, N. J.

385,259. Steering Apparatus for Vessels. Bradley A. Fiske, U. S. Navy.

"Claim 1: The combination, with an electric motor and a regulating switch having a movable arm, of a screw turned by the motor, a sleeve on said screw connected with said switch-arm, and a handle for turning said sleeve."

385,308. Electric Battery. Ernest M. Hewett, Newton, Mass.

"Claim 4: In an electric battery, a porous cup composed, essentially, of infusorial earth."

Reissue.

10,940. Electro-Magnetic Dental Hammer and Plugger. Philip Helmer, Clinton, Iowa.

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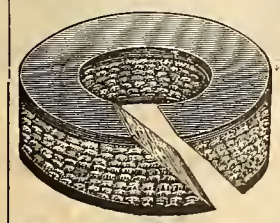

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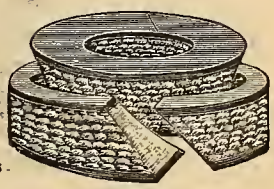

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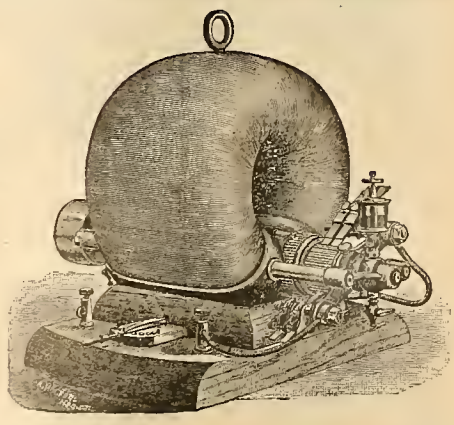

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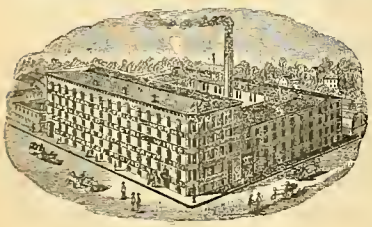

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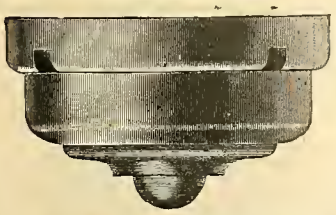

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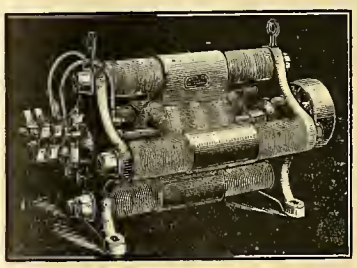

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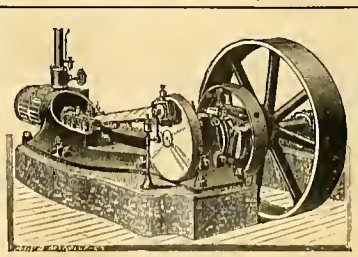

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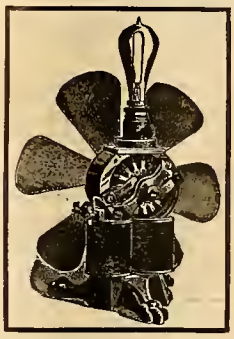

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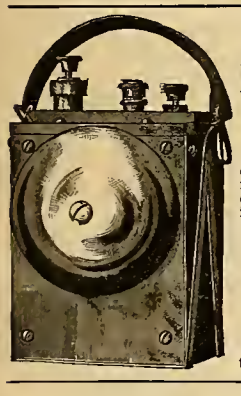

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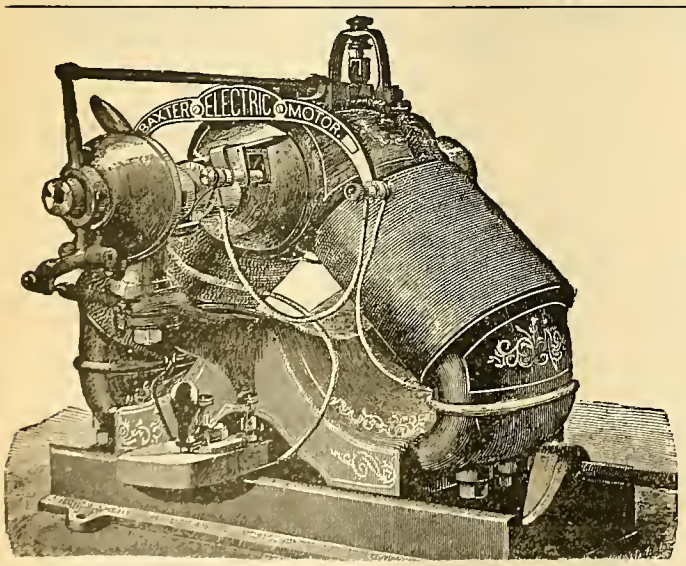

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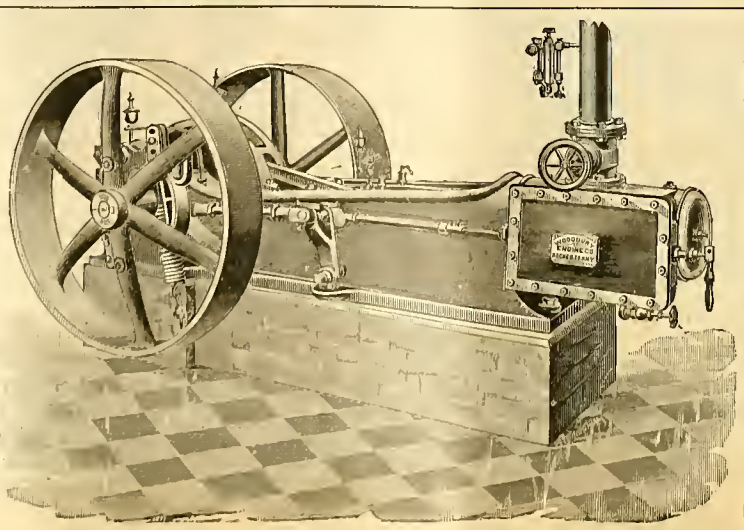

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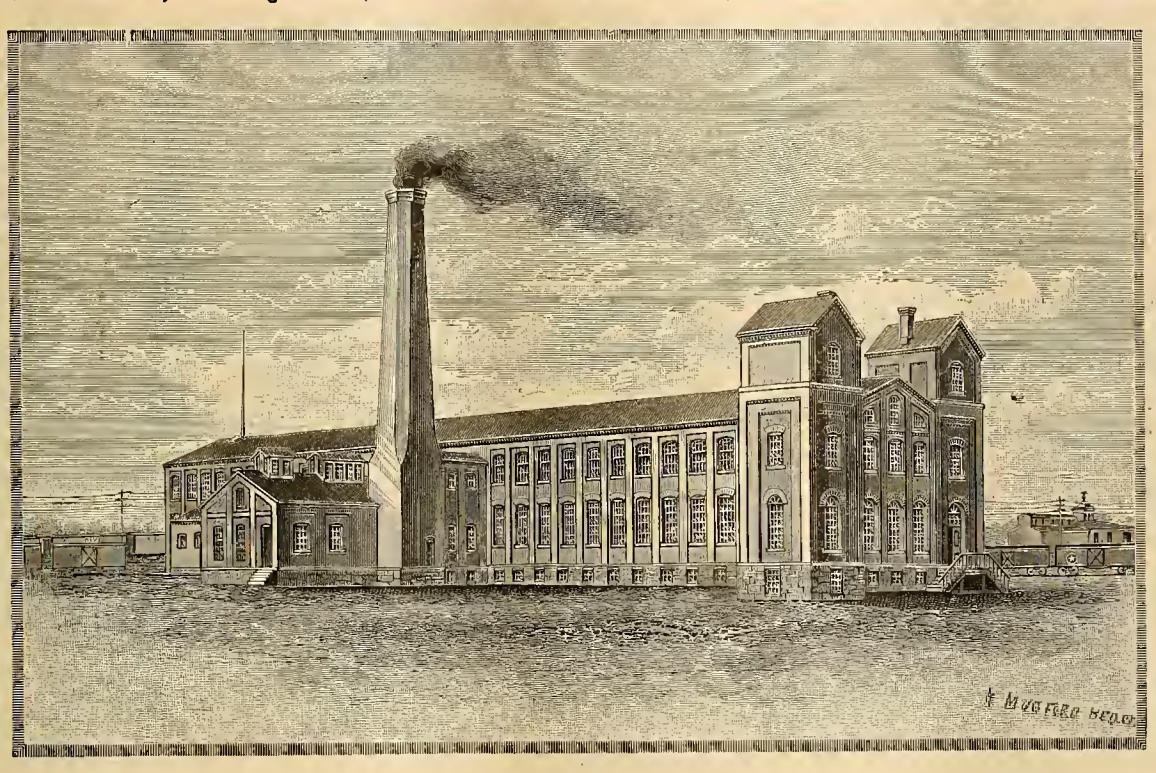

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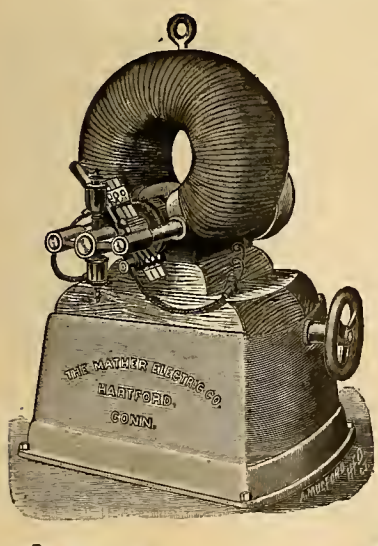

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TABLE OF CONTENTS.

	PAGE.
ELEMENTARY DATA—	
The Electric Current, Chapter I	1, 2
Ohm's Law, Chapter II	2
Work, Chapter III	2
Conductors and Insulators, Chapter IV	2
Direction of the Current, Chapter V	3, 4
Detector Galvanometer and Magneto Bell, Chapter VI	5, 6, 7
ARRANGEMENT OF POWER—	
The Dynamo Room, Chapter VII	8
Motive Power, Chapter VIII	8
Shafting and Pulleys, Chapter IX	9
Foundations for Dynamos, Chapter X	9, 10
Belts, Chapter XI	10
DYNAMO ELECTRIC MACHINES—	
Description of the Dynamo, Chapter XII	11
The Continuous Current Dynamo, Chapter XIII	11, 12, 13, 14
The Series Dynamo	11, 12
The Shunt or Derived Circuit Dynamo	12, 13
The Compound Dynamo	13, 14
The Alternating Current Dynamo, Chapter XIV	14, 15
Preparation of a New Dynamo for Operation, Chapter XV	15, 16
Starting a New Dynamo, Chapter XVI	16
Keeping a Dynamo in Good Order, Chapter XVII	12
Brushes, Chapter XVIII	17, 18, 90
The Commutator, Chapter XIX	19, 17
Repairs, Chapter XX	20, 21
To the Armature	20, 21
To the Field Magnets	21
Testing the Wire Coils of a Dynamo for Contact Against Iron, Chapter XXI	21, 22, 23, 24
DISEASES OF DYNAMOS—	
Non-generation of Current by the Dynamo, Chapter XXII	25, 26
Excessive Sparking of Commutator and Brushes, Chapter XXIII	26, 27
LAMPS—	
Arc Lamps, Chapter XXIV	28, 29, 30, 31
Suspension of Arc Lamps, Chapter XXV	31
Trimming and Cleaning Arc Lamps, Chapter XXVI	32
Incandescent or Glow Lamps, Chapter XXVII	32, 33
Multiple Arc System, Chapter XXVIII	33
Multiple Series System, Chapter XXIX	33, 34, 35
Series Multiple System, Chapter XXX	36
Arc and Incandescent Lamps on the Same Circuit, Chapter XXXI	36, 37 38
The Alternating System, Chapter XXXII	38
INSTRUMENTS—	
Current Indicator or Ampere Meter, Chapter XXXIII	39
Pressure or Potential Indicator, or Voltmeter, Chapter XXXIV	39 40
Current Regulator, Chapter XXXV	40, 41
Switches, Chapter XXXVI	41, 42
Safety Devices, Chapter XXXVII	42, 43
Lightning Arresters, Chapter XXXVIII	43, 44
Ground Detector, Chapter XXXIX	45, 46
Switch-Board, Chapter XL	46, 47
CIRCUITS OR LEADS—	
Outdoor Leads for Arc Lighting, Chapter XLI	48, 49, 50, 51, 52, 53
Outdoor Leads for Incandescent Lighting, Chapter XLII	53, 54
Arc Circuits Inside of Houses, Chapter XLIII	54
Incandescent Circuits Inside of Houses, Chapter XLIV	55, 56, 57
Size of Wires for Incandescent Lamp Installations, Chapter XLV	57, 58, 70
Testing, Chapter XLVI	58
ACCUMULATORS—	
Accumulators, Chapter XLVII	59
SAFETY REGULATIONS—	
Rules of the Boston Underwriters' Union	60, 61, 62, 63, 64, 65, 66
English Regulations	66, 67, 68
Abstract of the Chicago Electric Light Laws	68, 69
Table of Electric Light Conductors	70
Lamp Lighting Schedule—Moonlight System	71–82
Construction Tools	83–89

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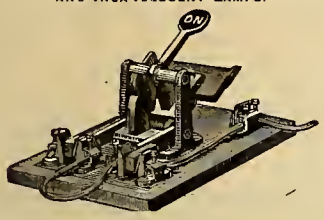

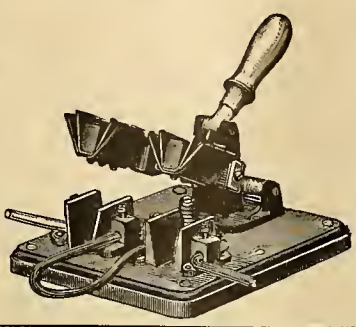

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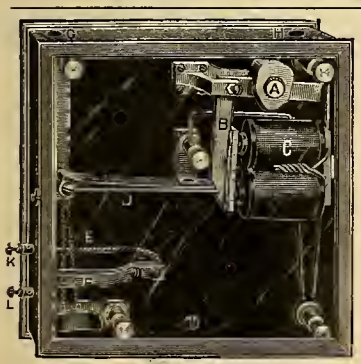

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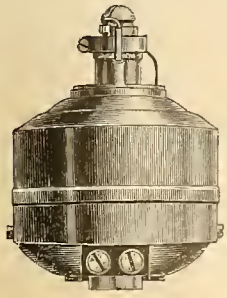

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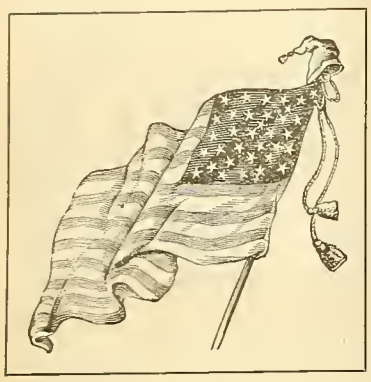

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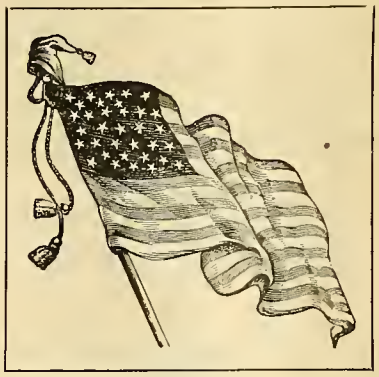

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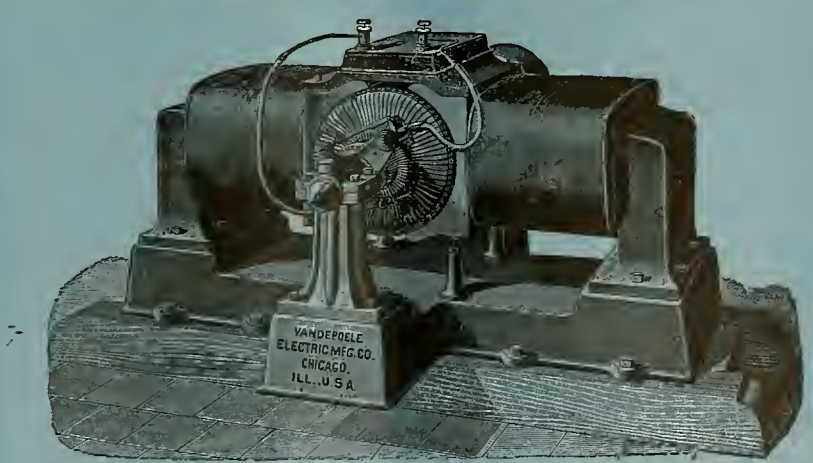

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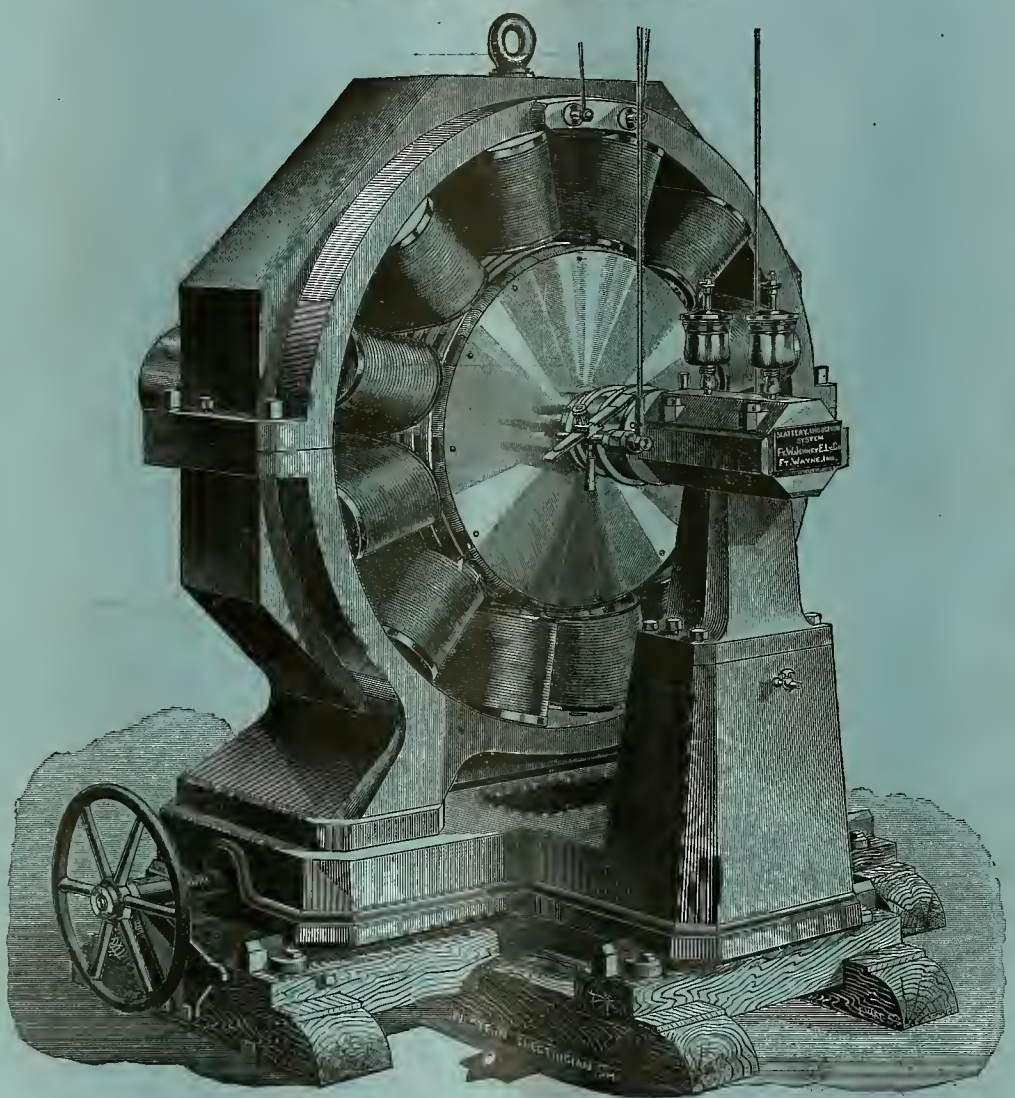

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Electric Light and Power. Telegraph and Telephone. Railway and all other Branches of Signaling.

All Sizes *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

CLARK B. HOTCHKISS, Gen'l Mgr., - 16 Dey St., NEW YORK.

Electric Leather Belting.

PIECE OF ELECTRIC BELT.

Wire Screwed, specially adapted for

DYNAMOS.

Every Belt Guaranteed.

CHAS. A. SCHIEREN & CO.,

MANUFACTURERS AND TANNERS OF

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CHES: { 46 South Canal Street, Chicago. 86 Federal Street, Boston. 415 Arch Street, Philadelphia.

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DUST AND BUG PROOF BELLS

ELECTRIC DOOR OPENERS,

Electrical House Furnishing

APPARATUS OF EVERY DESCRIPTION.

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The GALLENDER INSULATING and WATERPROOFING COMPANY,

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—MANUFACTURERS OF—

BITITE and TRINIDAD

INSULATED WIRES AND CABLES.

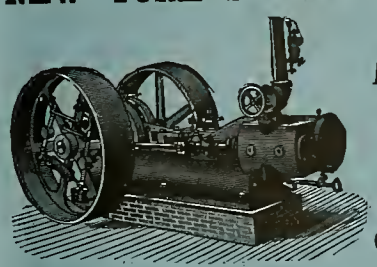
Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

TRINIDAD WIRES for Line Work in place of Underwriters.

ELECTRIC LIGHT WIRES of all sizes a SPECIALTY

NEW YORK SAFETY STEAM POWER CO.,

Builders of High Grade Self-Contained



Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.

WESTERN OFFICE AND WAREROOMS:

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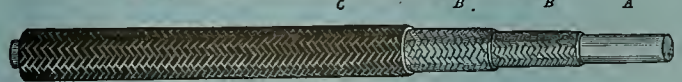
WM. A. HAMMETT, Manager.

ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.



CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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CHARLES D. JENNEY, Electrician.

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JENNEY ELECTRIC COMPANY,

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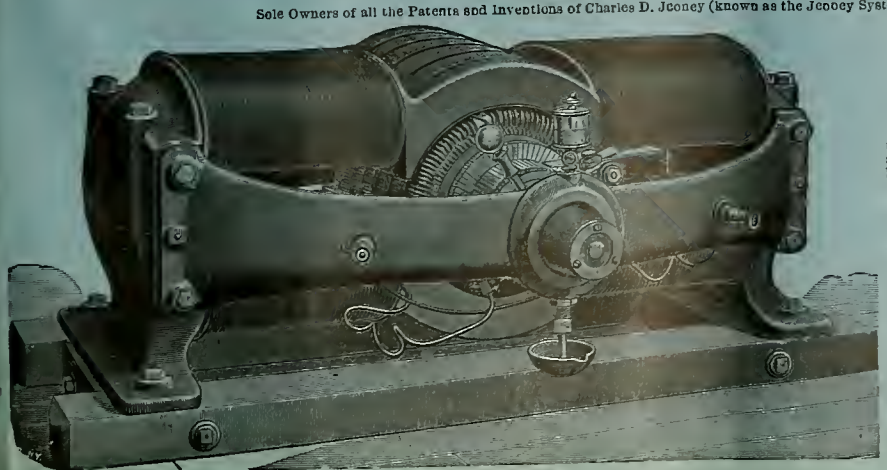
Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

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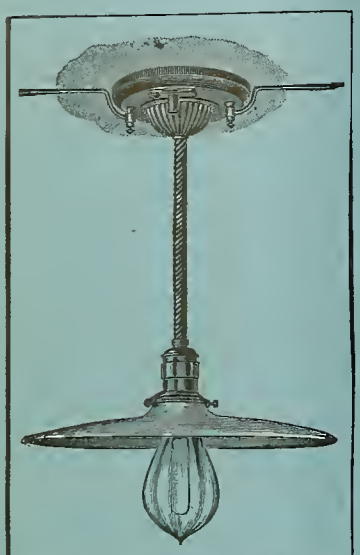
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



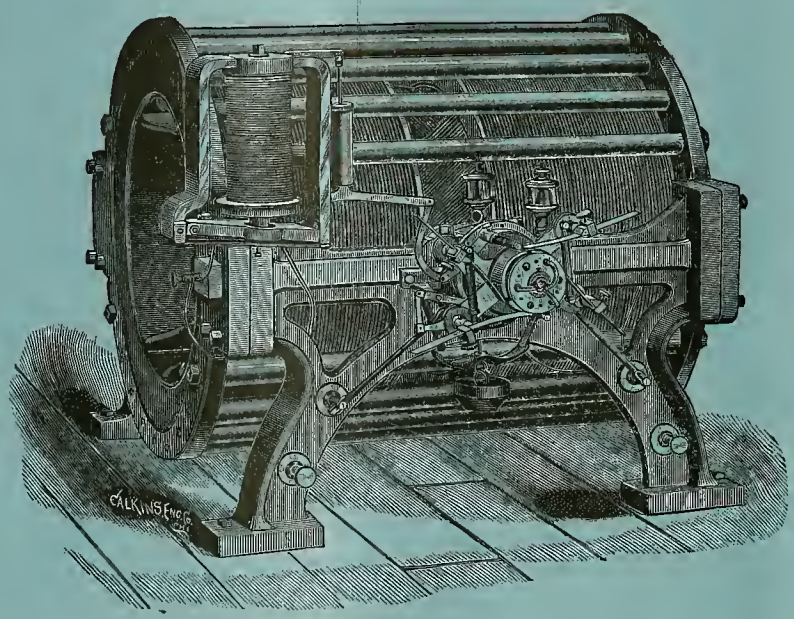
SERIES LAMPS

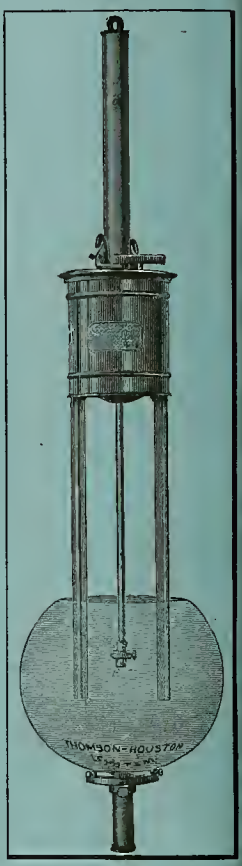
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



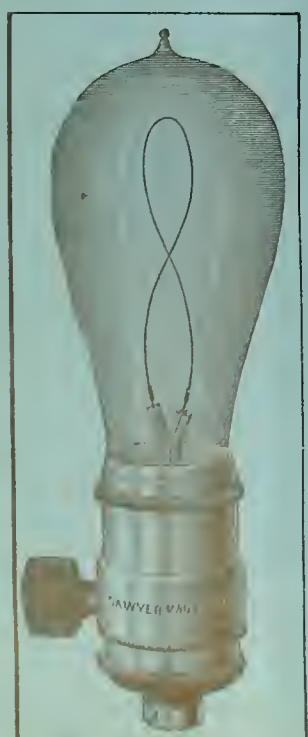


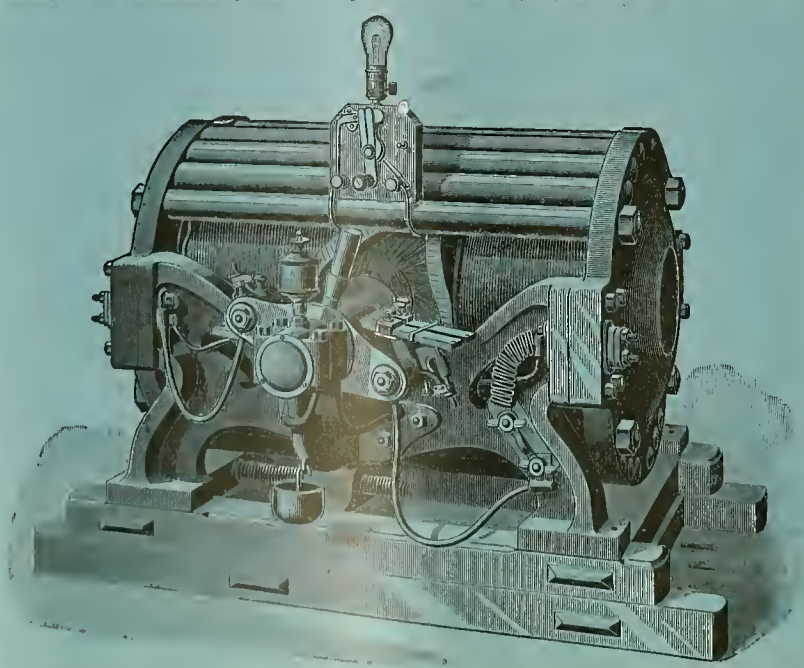
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,

16 & 18 BROAD STREET, NEW YORK.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{60}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager. 219 LA SALLE ST., CHICAGO.

The Railway Telegraph Supply Co.

54 and 56 FRANKLIN ST., CHICAGO,

Manufacturers of and Dealers in

ELECTRICAL APPARATUS AND SUPPLIES,

ANNUNCIATORS, MAGNETO BELLS, BATTERIES, ETC.

WE CARRY A FULL STOCK OF J. H. BUNNELL & CO.'S TELEGRAPH INSTRUMENTS.

Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

PAYNE AUTOMATIC ENGINE.

B. W. PAYNE & SONS, MANUFACTURERS, ELMIRA, NEW YORK.

BUILDERS OF

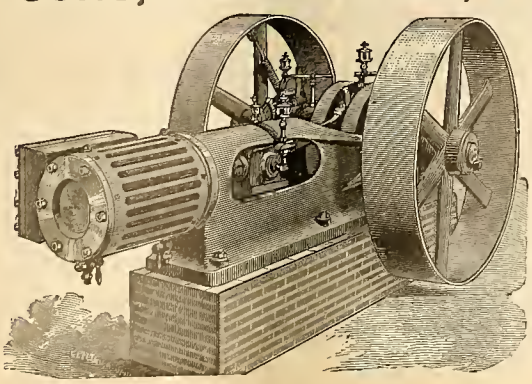
Single Valve and Corliss Valve

ENGINES.

SELF CONTAINED AND SINGLE CRANK

ENGINES

Specially Adapted for Electric Lighting.



WESTERN DEPARTMENT:

No. 10 S. Canal St.

CHICAGO.

H. S. WALKER, MANAGER.

TELEPHONE 4024.

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Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

JARVIS ENGINEERING COMPANY,

61 OLIVER ST. BOSTON. | 81 LAKE ST., CHICAGO. | 109 LIBERTY ST. NEW YORK.

H. A. GLASIER. Manager Western Dept.

CONTRACTING ENGINEERS FOR ERECTING COMPLETE STEAM PLANTS FOR

Electric Light and Power Stations

NATIONAL FEED WATER HEATER,
JARVIS BOILER SETTING, to burn Anthracite Coal and Coke Screenings
NATIONAL ROCKING and SHEFFIELD GRATE BARS.

SEND FOR NEW CATALOGUE.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

C. F. ANNETT, Prest. S. F. FENTON, Vice-Prest. and Treas. CHAS. SIDNEY SMITH, Sec'y.

Hotel and House Annunciators.
Electric Gas Lighting.
Fire and Burglar Alarms.
Electro-Medical Apparatus.
Electric Lighting.
Telegraph Instruments.
Wire and Batteries.

The United Electric Co.

Electrical Apparatus and Supplies.

SALT LAKE CITY, - UTAH.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

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Branch, Room 31 Water Works Building. 600 Walnut St., Kansas City, Mo.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
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32 NASSAU ST.,
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Plans and Estimates Furnished for all kinds of Incandescent Lighting.

SAWYER-MAN ELECTRIC COMP'Y. SAWYER-MAN SYSTEM. TRADE MARK

Philadelphia Office:
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BOSTON OFFICE:
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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

RICHMOND ROAD

SPRAGUE SYSTEM.

Total Trackage, 12 Miles. Maxmum Grade, 10 1-10 per cent.

Twenty-nine curves, such as a **27-foot radius** with **5 per cent. grade, 40-foot radius** with **8 1-2 per cent. grade**, etc.
Total Equipment, 40 Cars. Full size, 16-foot closed and 22 foot open cars. **30 Cars Now in Operation.**

COST OF OPERATING SIXTY PER CENT. LESS THAN WITH HORSES.

The present mileage of 1,500 to 1,800 miles on these grades would require not less than 225 to 250 horses.
The **entire operating expenses** chargeable at the Central Station for **thirty cars**, with the present mileage, on the **heaviest section** of the track, is **1½ cents per car mile.** This includes **electrician, engineers, firemen, dynamo men, all coal, oil, waste, water, lighting** and depreciation; the working force being, with the exception of one man, sufficient to handle forty cars. When the forty cars are in operation the expense will be reduced to about **1¼ cents per car mile run.**
Number of Miles Ran, 136,214. Passengers carried, 598,613. Schedule running time, 7½ miles per hour.

Total Operating Expenses, including everything, for the month of May, was only 47 per cent. of the Receipts.

Send for Map and Details of this Road.

SPRAGUE ELECTRIC RAILWAY AND MOTOR CO.,

16 and 18 BROAD STREET, NEW YORK.

WARNING.

We hereby notify the trade, and all parties manufacturing, using, or selling Insulated Wires, that by virtue of United States letters patent Nos. 306,744 and 308,890 respectively, we own the exclusive right to manufacture and sell

THE GRIMSHAW "WHITE CORE" INSULATED WIRES AND CABLES,

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE.

which patents cover broadly, not only the *White Core Insulation*, but also method of manufacturing and the machinery used in connection therewith, thereby giving us ample protection for our goods. Under advice of the Counsel of this Company, we desire to give *formal notice* that all infringements of the above patents, or any of them, by the manufacture, use and sale of *"White Core" Insulated Wires and Cables* will be promptly and vigorously prosecuted, and those who have used or sold Wires and Cables infringing our patents will be made to account to us for damages.

NEW YORK INSULATED WIRE CO.,

452 BROADWAY, - - - NEW YORK.

BAKER'S TRIPOLINE!

A Powerful and Rapid Cleaner and Polisher of Metals without Acid or Poison.
Especially Adapted to Railroad, Marine, Stationary and Fire Engine Work, "hot or cold:" Large Signs, Railings, etc.

This polish is now being supplied to Hundreds of Mechanical Engineers **ELECTRIC LIGHT PLANTS**, and manufacturers of Machinery. Has already been adopted by many of the leading railroad companies, the leading fire departments, water works the U. S Ordnance and Navy Departments, and thousands of Mills, Factories, etc. Is the BEST AND CHEAPEST POLISH IN THE WORLD, and quickest Cleaner. **Unequaled for Cleaning and Polishing Carbon Holders.** Send for Sample, FREE. Liberal discount to manufacturers and dealers in **Electrical Machinery.** Manufactured only by the

MATCHLESS METAL POLISH CO., - - 88 MARKET ST., CHICAGO, ILL.

THE DYNAMO.

HOW IT IS MADE AND HOW TO USE IT.

A complete Description of the Various Parts of the Machine, and how to take care of it. With other valuable Electrical Information for the use of those having charge of Electric Lighting Apparatus. Fully Illustrated, with many new Plates and Cuts.

Sent Postpaid on Receipt of Postal Note, Money or Express Order for **FIFTY CENTS.**

FRED M. KIMBALL & CO., Boston, Mass.

FRANKLIN S. CARTER CHAS. M. WILKINS. E. WARD WILKINS

ESTABLISHED 1867.

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

ELECTRICAL SUPPLIES.

SOLE PROPRIETORS OF THE
PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS.
WE MAKE A SPECIALTY OF
BELLS, DISQUE LECLANCHE BATTERIES, GAS-LIGHTING APPARATUS
AND A FULL LINE OF
SUPPLIES FOR ELECTRIC BELL WORK.

We publish Catalogues of all our Manufactures, and will forward to any address upon application.

N. B.—When applying for Catalogues, please state whether "Electric Bell" or "General Supply" Catalogue is wanted, and if in the trade inclose business card for discounts.

114 South Second Street. PHILADELPHIA, PA.

High Insulation

In order to meet the constantly increasing demands for

BETTER INSULATION,

THE BISHOP GUTTA-PERCHA CO.

420-426 EAST 25th STREET, NEW YORK CITY,

HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

FOR MAKING THE CELEBRATED

HOOPER'S CORE

AND OTHER RUBBER COMPOUNDS

FOR INSULATING WIRES FOR

Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

HENRY A. REED, Manager.

USE NOTHING BUT

GUTTA-PERCHA FOR SUBMARINE CABLES.

Use Marks' Compound Wire for Battery Coppers.

Use Balata Insulation for Flexible Cords.

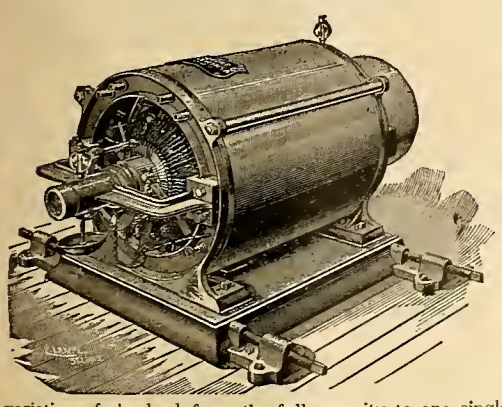
Heisler Electric Light Co.

809-817 S. 7th Street, ST. LOUIS, MO.

MANUFACTURERS OF

The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

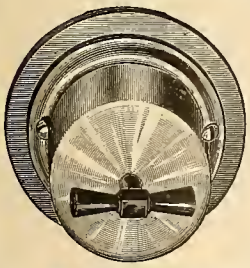
We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

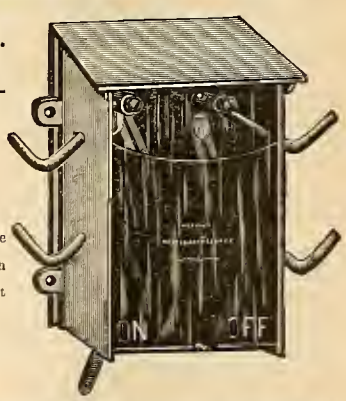
Forest City Electric Works,

Manufacturers of **CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,**

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.





Correspondence Solicited with Electric Light Companies.

W. B. CLEVELAND, Proprietor, 183 SENECA STREET, CLEVELAND, O.

Our BELTING is tanned on the surfaces only; the **INTERIOR is RAW HIDE.**

Send for Our Valuable Book for Engineers and Belt Users. Free.

Agents in all Cities. Send for Trial Belt.

Geo. Westinghouse, Jr., Pres.
H. M. Byllesby, Vice-President and General Manager.

John Caldwell, Treasurer.
A. T. Rowand, Secretary.
W. L. McCullagh, Auditor.

OFFICE OF

THE WESTINGHOUSE ELECTRIC COMP'Y,

The Westinghouse Electric Company respectfully calls your attention to the Confidential Circular to the Agents of the Edison Electric Light Company, printed over the signature of E. H Johnson, President, a reprint of which is given below; and also to the correspondence which passed between the officers of The Westinghouse Electric Company and Mr. W. W. Gibbs, Vice President United Gas Improvement Company, of Philadelphia, Mr. Eugene Vanderpoel, President of the Newark Gas Light Co., Newark, N. J., and Chairman of the Executive Committee of the Society of Gas Lighting (for whom a test was made), and Prof. Henry Morton, President of Stevens Institute of Technology, Hoboken, N. J., bearing on the subject matter of the confidential circular of the Edison Company.—We submit this without further comment.

THE WESTINGHOUSE ELECTRIC CO.,
Geo. Westinghouse, Jr., Pres.

Pittsburgh, Pa., July 3, 1888.

[Reprint.]

CONFIDENTIAL.

To the Agents of the Edison Electric Light Co.:

We are credibly informed that the Westinghouse Company made overtures to the United Gas Improvement Company (of Philadelphia), with a view to have them adopt the Westinghouse system for general introduction throughout the country.

The Westinghouse Company claimed that their system was better than the Edison, and offered to guarantee that the *construction* or *first cost* of a plant would be one-half of that of the Edison, and that the *cost of operation* would be much less.

The United Gas Improvement Company replied that if, instead of the proffered guarantee (upon which they evidently did not place much value), the Westinghouse Company would demonstrate by actual test that their so-called system was *as good as* the Edison, they (the United Gas Improvement Company) would undertake its exploiture and introduction. Competent tests were made of the Westinghouse system at Pittsburgh, Pa., Plainfield, N. J., etc, and of the Edison system in Boston and elsewhere. A Westinghouse plant was sent to the Stevens Institute, at Hoboken, N. J., and a thorough test was made by or under the direction of Prof. Morton, assisted by Profs. Denton and Geyer.

The tests were comparative, and made, of course, in the interest and for the information of the United Gas Improvement Company.

An exhaustive report was made, and (as we understand) twenty-four copies printed at a cost of $2,500.

This report has been very effectually suppressed, and in spite of the most strenuous efforts and detective work on the part of some of our friends, we have so far been unable to secure a copy of it. Nevertheless, we have been in communication with several different parties (unknown to one another) who have seen and read the report, and as their statements concerning it completely corroborate each other, we give the conclusions reached by Prof. Morton as they are given to us:

First. Notwithstanding the extravagant claims of cheapness, the construction or first cost of the Westinghouse Alternating or Converting system is practically the same as the Edison.

Second. The Westinghouse Company guarantee twenty lamps per horse power, and in practice get about six. The Edison Company guarantee twenty lamps per horse power, and in practice get about fourteen or fifteen. In other words, they cannot come up to the guarantee; we exceed ours.

Third. The *cost of operation* of the Westinghouse system is found by the experts engaged in the test to be very much greater than that of the Edison. This, of course, is the all important question to the investor.

Fourth. In point of general efficiency, reliability, distribution and regulation, the report says that the Edison system is far in advance of the Westinghouse, and that in these essential features the latter is not to be compared with the former.

Although, as before stated, we have not seen this report, nevertheless every one who has seen it gives us the same version of it, and it is known that, as a result of the tests, the United Gas Improvement Company has declined the Westinghouse Company's offer.

We give the information to our agents as it comes to us, in order that they may be aided in their efforts to refute the extravagant and fictitious claims made by the agents of the Westinghouse Company. If the statements made to us are incorrect (which we can hardly believe), our agents might suggest to intending purchasers or investors, that perhaps the Westinghouse Company may be willing to show them the official report of these tests, on the ground that they will be of greater intrinsic value than the enticing guarantees offered.

The following questions are also pertinent:

1. Why have not the United Gas Improvement Company adopted the Westinghouse system?

2. Why has the report of these tests been so vigorously suppressed?

3. If the Westinghouse Company, as they claim, have a system so superior to and so much cheaper than the Edison, and if, as they pretend, the Edison Company's patents are valueless, why do they desire to bring about a combination with the Edison Company?

The following extract from the New York Sunday "News," of May 27, is a fair specimen of the reports of this character which are constantly being circulated, and which lack even the faintest suspicion of truth:

BIG CONSOLIDATION OF ELECTRIC COMPANIES.

Pittsburgh, Pa., May 26.—It was current talk in this city to day, that the Edison Electric Company has offered terms of consolidation with the Westinghouse Electric Company of Pittsburgh. The terms, it is alleged, are not as yet quite satisfactory to the Westinghouse Company, but that the consolidation of the contending corporations will be speedily effected, is no longer doubted.

Upon investigation we find that this dispatch was received from Pittsburgh by the American Press Association, by whom it was then stereotyped and telegraphed to numerous daily papers all over the country.

4 Why are they constantly importuning Edison experts to come with them, if their own system has reached the state of perfection which they claim for it?

EDISON ELECTRIC LIGHT COMPANY,
By E. H. Johnson, President.

[Correspondence between officers of the Westinghouse Electric Company and the parties named in Mr. Johnson's Edison Circular.]

Pittsburgh, Pa., June 22, 1888.

United Gas Improvement Company, Philadelphia, Pa.:

Gentlemen,—We inclose you herewith a type-written copy of a confidential circular issued by the Edison Company to its agents. We shall be glad to hear from you by return mail as to whether, in your opinion, there is any justification for the statements contained in this circular as to your Company having had negotiations of the character referred to.

Yours very truly, THE WESTINGHOUSE ELECTRIC COMPANY,
George Westinghouse, Jr., *President.*

UNITED GAS IMPROVEMENT COMPANY.

Office 333 Walnut Street, Philadelphia, June 23, 1888.

George Westinghouse, Jr., Esq., President Westinghouse Electric Company, Pittsburgh, Pa.:

Dear Sir,—Your favor of 22d inst., which reads as follows, has just come to hand: "We inclose you herewith a type-written copy of a confidential circular issued by the Edison Company to its agents. We shall be glad to hear from you by return mail as to whether, in your opinion, there is any justification for the statements contained in this circular as to your Company having had negotiations of the character referred to."

I would reply, in a general way, that so far as the circular makes any reference to the United Gas Improvement Company, which, of course, is the only part of its contents of which I can state of my own knowledge, there is not one particle of foundation for the statements therein contained.

I will answer them specifically:

First. The Westinghouse Company never made overtures to the United Gas Improvement Company with a view to having them adopt the Westinghouse System for general introduction throughout the country, and therefore of course never made the claims or guarantees set out in the circular.

Second. The United Gas Improvement Company never having received any such proposition or proffered guarantee, could not have made, and did not make, the reply set out in said circular, that "if the Westinghouse Company would demonstrate by actual test that their so-called system was as good as the Edison, that the United Gas Improvement Company would undertake its exploiture and introduction."

Third. No tests of any kind were made in the interest of or for the information of the United Gas Improvement Company, and no report has ever come to our knowledge of any such tests.

This, I believe, covers the ground fully, and in order to assure myself that none of the other officers or heads of departments of our company were in possession of any information on the subject of which I was in ignorance, I have submitted your letter and the accompanying copy of circular to a full meeting of our managing committee, which is made up of the heads of all our different departments, and they all unite with me in the above statements.

Very truly yours, UNITED GAS IMPROVEMENT COMPANY,
By W. W. Gibbs, *Vice-President.*

Pittsburgh, Pa., June 22, 1888.

Prof. Henry Morton, Stevens Institute, Hoboken, N. J.

Dear Sir:—We inclose herewith a type-written copy of a confidential circular issued by the Edison Company to its agents. You will notice that the circular states: "We give the conclusions reached by Prof. Morton, as they are given to us." You can imagine our surprise that the report made by you and your assistants, of which the gentlemen have never supplied us a copy, should be so worded that any one could draw the conclusions that are attributed in this circular. Are the Edison people right in their statement of the case, or have they made a mistake?

Considering the fact that our company went to a very great expense in the matter of the investigation which was undertaken by you, we feel there is no reason why we should not have been provided with a copy of the reports that were made on our system.

Yours very truly, THE WESTINGHOUSE ELECTRIC COMPANY,
George Westinghouse, Jr., *President.*

STEVENS INSTITUTE OF TECHNOLOGY.

George Westinghouse, Jr.: Hoboken, N. J., June 23, 1888.

Dear Sir:—Yours of the 22d is just received. As regards the action of the Society of Gas Lighting in suppressing my report, I can only say that I had neither voice nor authority in the matter. I only received a copy many months after it was printed, on the condition that I would show it to no one except those engaged in the tests, and no one but Profs. Geyer and Denton has seen it. As to the statement in the Edison circular, I would say as follows: "I never made any tests of any electric lighting system for the United Gas Improvement Co., or made any report on such systems to them." The rest of the statements in the Edison circular are as untrue as their first one, which I contradict as above. I have never said *in any report to any one*, either exactly or substantially, any of the things attributed to me in said Edison circular. Very truly yours, HENRY MORTON.

Finally Mr. Eugene Vanderpoel, President Newark Gas Light Co., and Chairman of Executive Committee of Society of Gas Lighting, replies as follows:

OFFICE OF NEWARK GAS LIGHT CO.

George Westinghouse, Jr., Esq: Newark, N. J., June 23, 1888.

Dear Sir:—Your letter of June 20 has just been received. I have read the confidential letter you inclosed, and find its statements untrue so far as they refer to the report of our committee. The confidential letter states that none of the Edison people have seen the report, and I cannot see that our committee, or the members of the Society of Gas Lighting, who alone have copies of the report, should be held responsible for the imagination of Mr. Johnson.

The United Gas Improvement Company had nothing to do with the report, and have never seen it.

The report was made for and to the Society of Gas Lighting.

The committee, of which I was chairman, several times considered the question of sending you a copy of the report, and all desired to do so, but felt that some of the matter contained in it (although I think you already had the information from other sources) had been obtained confidentially from the Edison people, and we did not think it right to place it in your hands. Neither did we wish that our views, favoring your system so strongly above others, should be used for advertising purposes. We were placed in an awkward position, and thought it would be better to confine the report to the members of the society. I will at once send your letter to the other members of the committee, and get their views, suggesting that by the removal of the Edison confidential matter there will be no objection to sending you the report. Yours very truly, EUGENE VANDERPOEL, President.

In regard to the rumor reporting consolidation of the Edison and Westinghouse Companies, we would call attention to the following card from the Westinghouse Electric Company, which appeared in the financial column of the *Chronicle Telegraph* of Pittsburg, May 29:

A CARD FROM THE WESTINGHOUSE ELECTRIC COMPANY.

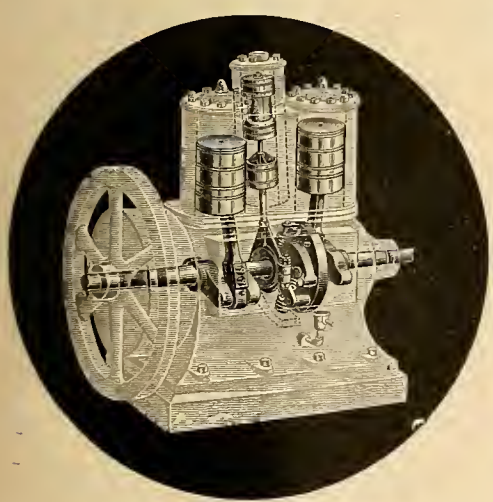
To the Financial Editor Chronicle Telegraph:

Lately there have appeared in your financial columns certain articles and statements relative to the Westinghouse Electric Company which are erroneous and inclined to produce false impressions. You will very greatly oblige the Westinghouse Electric Company by correcting the following more important: The statement with reference to the recent decision against the Edison Company which, as given in your columns, indicates that the Westinghouse Electric Company was the party prominently connected with the suit; whereas, it was a case between the Edison Electric Light Company and the United States Electric Light Company, wherein the pretensions of the Edison Company in reference to a large number of their patents, as set forth in their famous Red Book, were effectually disposed of.

In your last Saturday's issue, also, you headed your financial column "Edison's Greeting to Westinghouse." Nothing has transpired to justify the statements in this article.

Appreciating the position you occupy in financial matters in Pittsburgh, we respectfully call your attention to these facts. Very truly yours,

The Westinghouse Electric Co.



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CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, JULY 14, 1888. No. 2.

A New Focusing Lamp.

The illustration in connection represents a new style of focusing lamp invented by Ernest P. Warner, of the Western Electric company of Chicago. It is designed more especially for use on river steamers and can be used with various forms of reflectors and lanterns to suit the different kinds of work to be done. The main regulating mechanism consists of the well-known form used in the Western Electric arc lamps. The focusing mechanism, however, dispenses with the usual gearing and complication of parts and consists of a simple arrangement of pulleys in combination with a chain whereby the proper ratio of feed of the carbons is secured. The carbon supporting arms move up and down on independent vertical rods and are provided with anti-friction rollers which add greatly to the freedom and ease of movement of the working parts. A simple and effective device is attached to the lamp for bringing the arc into the focus of a reflector if at any time it should become thrown out of place by inequalities in the composition of the carbons. The lamp is mounted upon a strong cast iron base whereby it may be secured to a table or other support, and is in other respects so substantial in its mechanical construction as to preclude the possibility of its being easily damaged or thrown out of order.

This lamp can be readily adapted for use with any of the better known systems of electric arc lighting.

Electric Light in the Chicago Opera House.

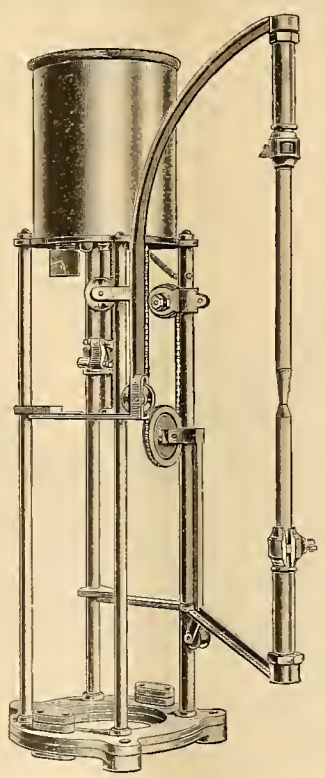
The great superiority of the electric light for theater lighting is admirably demonstrated at the Chicago Opera House, where incandescent lamps are employed for general illumination, decoration, and stage effect. That the lights add greatly to the beauty of the house goes without saying, but the most interesting part of the illumination is that carried on behind the scenes. In a spectacular piece like the "Crystal Slipper" brilliancy of effect is one of the prime considerations and in obtaining this desired result the electric light plays a modest though essential part. The beauty and effectiveness of the stage pictures are due in no small degree to the illumination which gives the desired glitter and sparkle. The easy operation of the lights and the flexibility of the system make it possible to secure effects which it would be impossible to attempt by old fashioned methods.

There are 800 lights in the theater, current for which is supplied by two Edison dynamos. The lights in the auditorium and on the stage are controlled at the switch board located on the prompt side of the stage. The switch board which is about 7 feet square, contains 12 switches. It is illuminated by three incandescent lamps. The electrician in charge, Martin Krueger, has his hands full during a good part of the performance and his manipulation of the lights is an interesting piece of work. The lights on the stage number a little over 200. In the footlights are 35 lamps. The five borders contain an average of 31 lights each. A dozen or more lamps form the movable ground lights. The other lights on the stage are bunched in reflectors for the illumination of the sides.

By the use of resistance coils the lights can be dimmed instantly. When the curtain rises the pretty effect of this dim light is noticeable. The prettiest changes in spectacle are the sudden transformations from total darkness in the auditorium and stage to a blaze of light in every part of the theater. The change is fairly dazzling. At a word from the stage manager, Mr. Krueger turns to his switch board and sets to work with both hands in turning on the lights. In this way the change is made almost instantaneously and it is for this reason alone the effect is so brilliant. With no other illuminant could such an effect be produced. Throughout the entire operetta pretty effects are obtained by a judicious use of the lights, and they contribute not a little to all the scenes.

At present calcium lights are used on the stage but they will soon be replaced by arc lights with reflectors—a change of no little importance. The fact that the arc light can be extinguished instantly is an important element in its favor, not to mention its brilliancy. An arc plant will be installed in the theater so that an absolutely steady current may be sustained.

Mr. Krueger is enthusiastic in his admiration



of electric illumination for theaters. "The electric lights," he says, "are infinitely superior to gas. We could not use gas in such a piece as this in which quick changes are necessary. If the border lights were turned out with gas it would be necessary to go round with a torch to light them again. We keep making changes in the system in little matters of detail where we see that improvements can be made. We are extending the system too, as we find we can use it for new purposes to take the place of gas. The fact that the lights do not add to the heat is an important argument in favor of their use on the stage in such weather as this. The heat from a row of gas footlights is terrible on a hot night. The safety of the lights, too, is another important consideration. We have had no trouble with the system. We have had a few grounds, but as we keep pretty close watch of the circuits no harm has resulted."

Gas lighting in theaters is becoming an old fashioned method of illumination and will soon be obliged to give way generally to a better mode.

Charters for Rapid Transit Companies.

The residents of the west division of Chicago need rapid transit. Several companies have petitions for charters before the city council, but no action on these will probably be taken before the summer vacation of the aldermen. The charters are locked up in committee rooms. Among the companies which ask for privileges are the following:

The Chicago Rapid Transit company, which represents a large portion of the substantial citizens of the west side, proposes to erect an elevated railway. The line of this road is to commence at Randolph street and the Chicago River, thence west on Randolph street to Union park, thence on Lake street to Crawford avenue. It is also proposed to erect a line connecting at Randolph street with Ogden avenue and extending to Lawndale. Both lines are to be double tracked, and trains are to be run at frequent intervals. The plan adopted by this company is similar to that now in operation on the Second avenue line in New York City. The road bed is to be supported by iron columns about twelve inches in diameter, erected on the curb line; upon these posts will be placed iron girders or spans, extending across the street. The tracks will be placed in the middle of the street, so as not to interfere with the upper floors of the buildings on the streets over which the line is to run. No interference with surface travel can possibly result from this style of road. The trains will be propelled by small locomotives, and the cars will be heated by steam and lighted by electricity. Handsome stations, lighted and heated, will be located at distances not exceeding four blocks. The law requires the consent of a majority of the property owners in each mile of road for the erection of the same before the granting of an ordinance allowing the company to commence operations, and thus far the company claims to have secured more substantial and encouraging support than was expected at the outset. If a charter or franchise is granted to this company, the managers assert that they will be able to proceed at once with the erection and equipment, and be in full running order within twelve months from the time the franchise is granted.

Another plan contemplated is to erect an elevated road along the entire length of Lake street from the Chicago River westward. This plan is known as the Meigs system, and consists of a single post and track road, which may be built either over the sidewalk or center of the street. The cars are to be circular in shape, with the motive power in the front end of the forward car. There is only one track to be used, the wheels of the cars being set upon diagonal axles at an angle of about 90 degrees, and both converging to the single rail in the center, upon which they are secured and propelled.

There is another system that proposes to propel the trains by electric motors, and this company desires the broadest and freest sort of a franchise. It is asserted that this company proposes eventually to build a road on Clark street from the Chicago River to Thirty-ninth street and branch roads on Twenty-second, VanBuren, Madison and Lake streets, from Clark street to the western limits of the city. This road is to be practically managed by Louis Wahl and John Hannahs, but thus far the chairman of the coun-

cil commitee having the matter in charge alleges that the signatures of the property owners for the necessary right of way have not yet been procured or presented to the committee.

Sir William Thomson's Composite Electric Balance.[1]

By Thomas Gray, B. Sc.

A new form of electric balance has recently been introduced by Sir William Thomson, which can be adapted either for the measurement of volts, of amperes, or of watts. In the forms hitherto made the range for current is from 1-50th of an ampere to 500 amperes for continuous currents, and from 1-50th of an ampere to 250 amperes for alternating currents. The range for volts is, as in all such instruments, only limited upwards by the resistance available; but, as the resistance of the potential coils is about 40 ohms, the lowest potential which can be accurately measured is about 1 volt. These coils are of copper wire, and, in consequence of the high temperature variation of that metal, very high accuracy is not attainable for such low potentials as necessitates the use of the balance without any resistance in its circuit external to its coils. Potentials of from 10 volts upwards may, however, be measured with almost perfect accuracy with this instrument by introducing sufficient non-inductive resistance of platinoid or German silver wire into the circuit. For the measurement of potentials on alternate current systems there should be at least 500 ohms of non-inductive resistance in the circuit.

The general form and construction of the balance will be better understood by reference to Fig 1. Two coils of silk covered copper wire A B, made in the shape of anchor rings, are fixed to the two ends of a light aluminium frame C, which forms the beam of the balance. This beam is suspended in such a way that the planes of the coils are approximately horizontal, by two flat ligaments, one of which is shown at D, consisting of twenty copper wires, each about 1-10th mm. diameter. The suspension ligaments are about 1.5cm. long, and are attached at their lower ends to two insulated brass tubes, carried on a trunnion E, which passes across the middle of the aluminium frame. Their upper ends are attached to round pins F, fixed horizontally, and with their length parallel to the trunnion, in two brass uprights, which are screwed to the sole plate G, of the instrument. The suspension ligaments

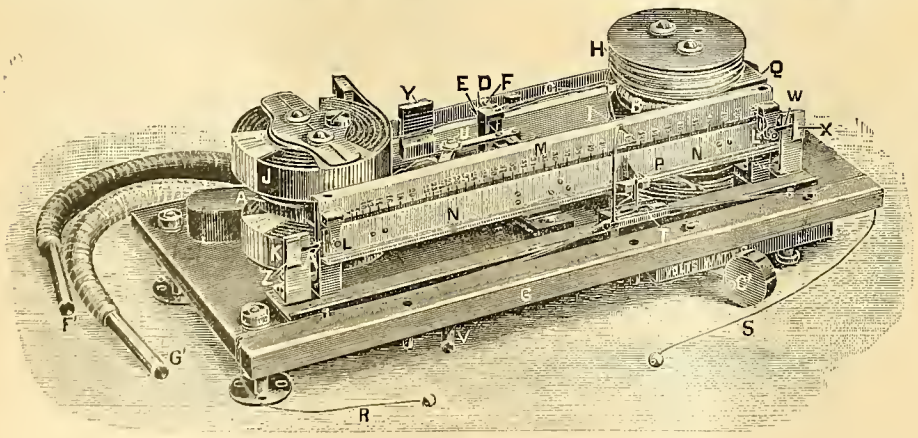


Fig. 1.

serve the double purpose of forming a flexible elastic joint about which the beam can freely turn, and of conveying the current into and out from the coils fixed to the beam. These movable coils are about 8cm. mean diameter, and the cross section of the ring is about 1 sq. cm. Symmetrically placed with reference to each other and the suspended coil, one above and the other below the coil on the right hand end of the beam, are fixed two coils H I of silk covered wire similar to that used for the movable coils. These coils have about the same mean diameter; but the cross section is rectangular, nearly square, and about 4 sq. cm. in area. Similarly placed with reference to the coil on the left hand end of the beam, are fixed another two coils J K, which are capable of carrying strong currents. When the instrument is specially designed for continuous currents, these coils are made of copper ribbon of sufficient thickness to carry 500 amperes safely. When the instrument is intended for alternating currents, the conductor consists of a rope of thin copper wires, each of which is silk covered to insulate it throughout its length from the others. The ends of all the wires are soldered together; and in order to avoid, as far as possible, error due to irregular distribution of the current across the section, the rope is given one turn of twist for each turn which it makes round the coil. Two turns of this rope is sufficient for each coil, and the maximum current is 250 amperes. The bobbins on which the fixed coils are wound, and the sole plate of the instrument, are made of good insulating slate, and the beam of the balance is cut at each end, so as to avoid Foucault currents in the frame work and sole plate.

To prevent excessive shake during the use of the instrument, and for convenience of portability, capstan headed stop screws L are attached to the supports at the ends of the fixed scale M, and to an upright at the middle of the suspension trunnion. In the ordinary use of the balance these stop screws are turned until they are just clear enough of the movable scale N, which forms the front bar of the beam and of the trunnion, to allow the beam to swing freely. For packing, the trunnion screws are turned back, the beam lifted up against two stops above the trunnion, and two packing pieces containing V's for the trunnion slipped between them and fixed by the screws, while the screws at the end of the scale M are screwed so as to grip the movable scale. The instrument may then be carried about, or sent anywhere, with perfect safety under ordinary usage.

The method of using this balance is similar to that of the other balance, already fully described in these columns. The instrument having been leveled, and the stop screws adjusted so as to limit the shake, as above indicated, the proper weight is put on the carriage P, and the corresponding counterpoise weight in the trough Q, and the zero adjusted. Before making the adjustment the carriage and weight are moved to the zero of the movable scale by pulling the cords R S, which move the slider T. Having set the index of the carriage exactly to the zero line, using the lens which is supplied with the instrument, if necessary, the flag U should be turned by moving the handle V until the index W on the end of the scale points to the middle one of the five black lines on the vertical scale, when the beam is allowed to swing freely and come to rest. Should by any accident the flag not have sufficient power the mass *y* on the back bar of the beam may be slipped a little to one side, until the flag is able to make the adjustment. A second vertical scale Z is fixed at the left hand end of the beam, and the index A should point to the middle line of it when the index W points to the middle line of X. The two scales are placed in the instrument to allow the observer to see whether by any accident the ligament has been elongated since it left the maker's hands. Such an elongation of the ligament may

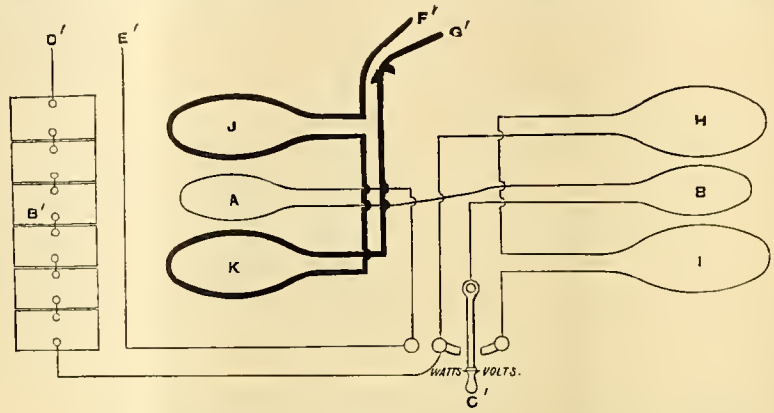


Fig. 2.

take place with rough usage, and a slight change of constant would be the result, but it very rarely occurs. The mode of using the balance for the different classes of measurements will be more readily understood from the diagram Fig. 2. In this diagram B_1 represents a set of non-inductive resistances of suitable magnitude for the potential of the circuit to which the suspended coils are to be connected. Suppose, in the first place, that the balance is to be used as a voltmeter. The handle C_1 of the switch is turned to volt, and the electrodes D_1 E_1 connected to the points whose difference of potential is to be measured. The current then flows through the electrode E_1 and the suspended coils A B to the switch, then from the "volt" terminal through the fixed coils H I to the "watt" terminal and from that terminal through the resistance B_1 to D_1. As the result of this current, the right hand end of the beam is deflected upward, and the weight has to be pulled toward the right in order to restore the balance. The distance through which the weight has to be moved gives the couple produced by the amperian forces between the coils, and from the constant supplied with the instrument the potential between D_1 and E_1 is deduced. It will be seen that by this method of using the balance, small currents may be measured. It is, in fact, a modified centiampere balance. The maximum current these coils are expected to carry is 1 ampere, and currents from 1-50 to 1 ampere may be measured in this way.

Next suppose the instrument is to be used as a wattmeter. The switch handle is turned to "watt," the electrodes D_1 E_1 connected to the supply mains, and the electrodes F_1 G_1 of the current coils J K connected to the two sides of a break in one of these mains. The whole current passing that break flows through the coils of J K and a current proportional to the difference of potential between the mains flows through the movable coils, but not through the fixed fine wire coils. The left hand coil of the movable system is thus acted upon by a force proportional to the product of the difference of potential between the mains and the current passing through them—that is, proportional to the rate of working in the circuit.

For the measurement of current the strength of which exceeds 1 ampere, the instrument is used heterostatically—that is to say, a constant measured current is passed through the suspended coils, and the current to be measured is passed through the fixed current coils. The connections for this use of the instrument are the same as for the measurement of watts. When a constant e. m. f. is available, the current passed through

[1] *Industries.*

the suspended coils may be measured by the instrument itself, by first turning the switch to "volt," and adjusting an external resistance so as to obtain the required current, and then turning the switch to "watt," and at the same time increasing the external resistance by an amount equal to the resistance of the fixed coils H I. Generally, however, a separate indicator or galvanoscope requires to be used in circuit with the suspended coils of the balance when it is used for the measurement of amperes. This indicator can, of course, be standardized by the balance itself, arranged for the measurement of small currents, and it need not be capable of measuring change of current, but it should be sensitive to such change.

An Automatic Ground Switch.

It is difficult to comprehend how a switch that has no ground connection or third wire, and which is as simple in its mechanism as this switch seems, can, without manual intervention, detect the slightest ground upon any particular loop which it is set to guard, and cut that loop entirely free from the main circuit the instant that such ground appears, thereby saving possibly both life and property.

When a ground occurs on a circuit, a second ground is almost invariably developed at the point of weakest insulation, and at a great difference of potential from the first. The current passing between these grounds causes destructive fires to ensue from sparks being formed at the points of ground and by the volatilization of substances in this abnormal path of the current. If these currents can be instantly removed as soon as they develop, no bad effects will be caused. These currents operate always to short-circuit the lights upon the main line and intermediate loops between the two grounds and compel the circuit to be shut down as soon as it is possible, but generally not before substantial damage is done; then comes the search for the cause, but sometimes when the location of one of the grounds is all too apparent from the havoc wrought, the other and co-operating ground is difficult to find and much delay and trouble is experienced in its discovery. The operation of this switch does away with these troubles and indicates where the fault in the line exists. The main line is always kept running and free from grounds, and the instantaneous removal of the faulty portion even before the full force of the ground has developed, saves the resultant harm. The operation is so perfect that the removal is absolutely without spark at the point of ground. This is invariably the case and may be demonstrated by coupling the switch temporarily in circuit at the station, and testing its capabilities. The isolation of the defective portion is perfect, so that repairs may go forward without delay or danger.

Fig. 1 represents the exterior view of the switch. Binding posts are provided for the terminals of both the line and loop circuits, as indicated. The body of the switch is entirely out of circuit, and is made as far as possible moisture proof, and is covered thoroughly with a special heavy coating of gutta-percha and japan. The interior portions are thoroughly insulated and covered with a preparation of asbestos, conforming throughout with the rules and regulations of the board of underwriters. The handle projecting downward is for the purpose of throwing the main line to the loop. The small button also shown is for the purpose of manually cutting off the loop by merely pushing upon it. A padlock attachment, not shown in the cuts, is also provided by means of which the switch may be locked when cut out so that no one can succeed in throwing it on while men are working upon the loop.

In Fig. 2 a spring will be seen which connects the two outer extremities of a knee and toggle-joint system of levers which are disconnected from the switch arms, the joints of which are brought by the direction of the handle almost exactly into line, and in the best position to easily resist the action of the spring. A catch is provided to hold the system of levers in this position which is operated automatically. This catch cannot be jarred out of position no matter how severe the concussion. The contacts are of the double lipped species, are always perfect and offer no resistance to the passage of the current.

The Electrical Supply company of Chicago are placing this switch upon the market.

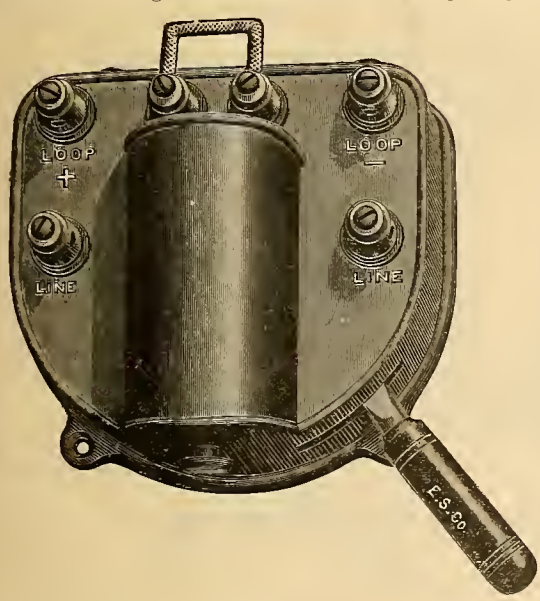


Fig. 1.

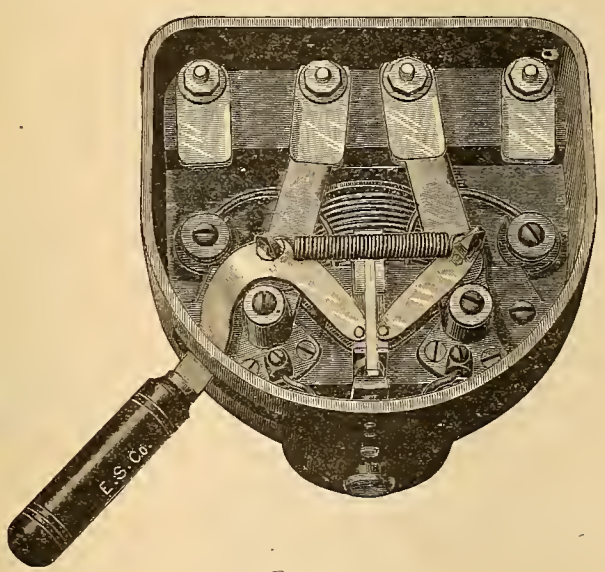


Fig. 2.

American Electric Manufacturing Company.

The American Electric Manufacturing company has had, of late, one of the most bitterly conducted oppositions with which any corporation has had to contend, says the New York *Press* of June 22d. Some little dissension from within and much open hostility from the part of rival concerns made at one time its existence questionable. Though it had earned in profits more than $500,000, yet the extent of its operations, not only over all this continent, but embracing the greater part of Europe, China and Japan, and the vast amount of money requisite to push its business, made it temporarily embarrassed, when through a series of combinations a concerted attack was made upon it.

It has triumphed, however. The adjourned annual meeting which was held yesterday afternoon developed a unanimity of feeling among the stockholders favorable to the company that has placed it on, if possible, even a surer basis than when it first started out. The company, on the patents which it holds, alone has spent in developing them a sum equal to nearly triple their original cost, and during the interim which has existed when the company was coping with difficulties that had unexpectedly presented themselves, orders aggregating more than $100,000 had been received.

The latter fact, displaying as it did an inherent and intrinsic worth in the company, together with some revelations which seemed to point to the presence of rival concerns in endeavoring to embarrass matters, welded the stockholders into union yesterday. The latter are willing to put up not only money sufficient to meet the emergencies thrust upon them, but to advance such sums as will enable the company to even more vigorously prosecute its work. The election of officers resulted in the choice of a very strong board, as follows: R. N. Hazard, of American Loan & Trust company, New York; Levi M. Bates, of L. M. Bates & Co., New York; H. S. Hyde, President of Agawam National bank, Springfield, Mass.; J. H. Bidwell, of H. S. Collins & Co., bankers, Collinsville, Conn.; J. W. Hinkley, Poughkeepsie, N. Y.; L. J. Fitzgerald, state treasurer, Cortland, N. Y.; A. R. Brown, manager Electrical Development & Manufacturing company, Boston; E. D. Jones, state senator, Pittsfield, Mass.; W. H. Roberson, of R. G. Dun & Co., Albany, N. Y.; David Prouty, capitalist, Spencer, Mass.; H. C. Adams, late treasurer American company, New York; Wm. J. Osborne, broker, New York; Edwards H. Goff, New York.

R. N. Hazard was elected president, and F. M. Louden secretary and treasurer of the company.

Chicago Electric Light Franchises.

The Chicago common council devoted its time to the consideration of electric light franchises at the meeting of July 2d. The ordinances were disposed of rapidly, a striking contrast to the postponements which had previously been in order when the matter was taken from the table. The only objection to the passage of the franchises was made by several aldermen who thought it was unwise to give such valuable privileges to companies if the council proposed in the near future to light the city by electricity.

The Sun Electric Light ordinance which gives the company the right to lay wires for furnishing "light, heat, power and signals" in the territory bounded by Adams and Twenty-second streets, the lake and the river, was passed on condition that the corporation pay 5 per cent. of its gross receipts into the city treasury. Several aldermen thought this percentage too high and suggested a substitution of two and one-half per cent., but the suggestion did not meet with favor.

The aldermen next took up the ordinance for the North Side company, covering the territory from Superior street to Chicago avenue, west to Ashland avenue, east to Halsted street from Milwaukee avenue, and east to Halsted street. The franchise was awarded on the same basis of percentage.

The ordinance of the Consumers' Electric Light company, granting it the right to light the territory in Blue Island avenue between West Harrison and Twelfth streets, and between Henry street and West Twenty-second street on Blue Island avenue, and across any streets intersecting Blue Island and between said points, and in South Halsted street from West Harrison to West

Twenty-second, was next taken up in the same manner and passed with an amendment requiring the payment of 5 per cent.

The ordinance of the Coöperative Electric Light company, giving it the right to light the entire North side south of Fullerton avenue, was next taken up and adopted on the same basis.

A provision of all the ordinances is that: "The company shall build conduits of their own and shall allow the wires or conductors of any other person or persons, company or corporation, to be placed in said conduits at an annual rental equal to that charged by any other conduit company. They shall permit the city of Chicago to use the conduits free of cost to said city, and where streets or alleys shall be crossed by connecting lines, wires, or conductors, which are run under or in sidewalks, such lines, wires, or conductors shall be laid as directed by the commissioner of public works. All such lines or wires shall be underground, properly insulated, and shall be constructed under the supervision and to the satisfaction of the commissioner of public works, or such other officer or department of the city government as may hereafter be designated by ordinance to perform the duties of such commissioner. No wires shall be laid unless a plat shall be filed with the commissioner of public works designating the streets, squares, and alleys in which it is proposed to locate the same, and a plat of the circuit of wires completed shall be filed with the commissioner of public works before the same are used, and any change in the same shall be reported to the commissioner of public works."

The companies have not yet decided whether they will accept the ordinances. They are inclined to think that 5 per cent. of the gross receipts is a rather large amount to pay for the privilege of conducting their business.

Direct Electric Welding Machine.

In the list of electrical patents published this week is one, No. 385,386, issued to Elihu Thomson, covering a direct electric welding machine. Appended is a description of the apparatus, given substantially as it appears in the patent specification:

"In my former patents on electric welding, I have assumed that current is derived from a source external to the welding apparatus—such as an alternating current dynamo—which current, by means of a suitable induction coil, generates heavy currents adapted for welding. This kind of welding or forging apparatus is useful in places where alternating currents can be supplied conveniently, but will not be of use in places where such currents cannot be obtained, and for this reason I have invented the following improvement in apparatus for electric welding, which consists, essentially, in the combination of suitable clamping devices for holding the pieces to be welded in the desired positions, and a dynamo for producing electric currents, and forming part of the same apparatus, which I term direct electric welding or forging machines, in contradistinction to the apparatus requiring currents from a source external to itself.

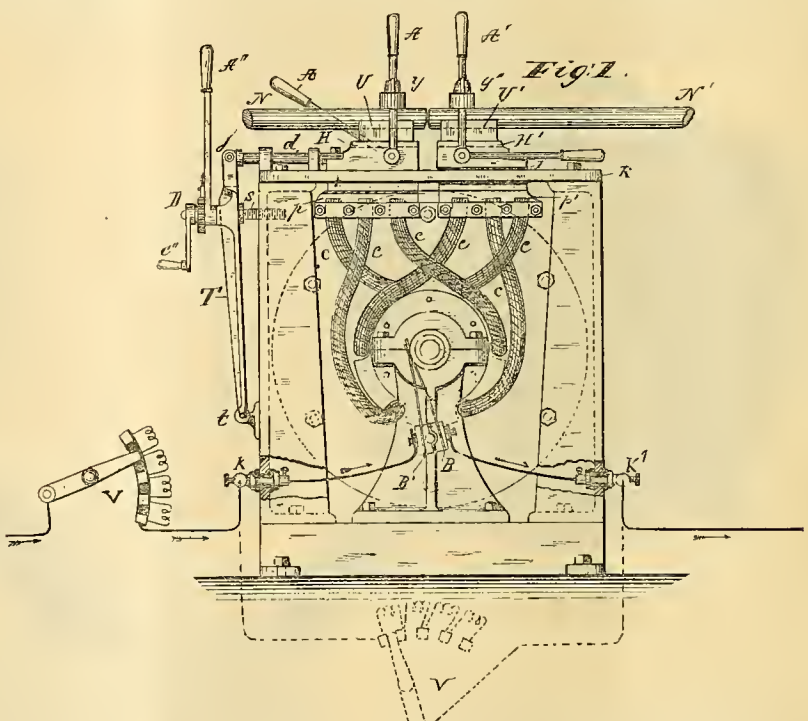
"My invention consists, briefly, in the combination, with a dynamo electric generator, of suitable clamping devices for holding the pieces to be welded in the desired position, and means for conducting the currents directly to the clamping devices, which are mounted on the frame of the apparatus. My invention also consists in the construction of particular forms of such apparatus, and of parts and details.

"The many special and useful advantages of my invention are obvious. Some of them may be mentioned: Its compactness renders it easily movable from place to place; the direct combination of a dynamo electric generator, with clamping devices for holding the pieces to be operated upon, renders the machine convenient in form and easy of manipulation and regulation; it generates its own welding current—a condition absolutely essential where electric currents cannot be obtained. It may be noticed, further, that there is a saving of weight and at the same time a saving of current, for the reason that long conductors are not needed to convey the current from the electric generator to the holding clamps.

"In the accompanying drawings, Fig. 1 is a front elevation of a convenient form of my improved direct electric welding machine. Fig. 2 is a side elevation of the same apparatus, showing a partial section of the field magnets and armature, and an end view of the holding clamps.

"In my direct welding machine it is essential to use a dynamo electric generator which is capable of producing welding currents of great volume, but low electromotive force between the clamps holding the pieces, and I have found a convenient form of such machine to consist of a revolving field magnet built up of laminated cores, bolted firmly together, and copper wire bobbins, producing alternate north and south poles, and an armature with laminated iron core wound with heavy copper wire bundles or cables. The field magnet of such a machine can be either separately excited, or may be excited by currents generated in its own armature and commuted by a suitable commutator placed on the revolving field magnet shaft of the machine.

"Referring to Fig. 2 of the accompanying drawings, F is a part section view of the field-magnet core, showing lamination, F being a part side view of the complete field. The core is fastened by means of lugs and bolts to a disk or plate, N, fixed on the shaft, S S,' of the machine, and is made to revolve by the pulley, P.



"While I describe the field magnet core of my direct welding machine to be built up of laminæ, I do not limit myself to this form. The field magnet cores may be solid; but such an arrangement is attended with loss of energy, and is therefore not so economical as a laminated field core.

"The armature of my direct welding machine may be made in the following way: Referring to Fig. 2, E represents a part sectional view of the laminated iron core of the armature, the lamination being represented by fine vertical lines. These laminæ are bolted firmly together, as indicated in the figure.

"The special advantage of winding the armature with conductors or cables consisting of a number of copper wires insulated from each other is that the insulation prevents lateral contact of the wires, and therefore prevents the generation of the intense eddy currents which would otherwise be produced. In this way considerable waste is avoided.

"The dynamo machine, constructed preferably in the manner before described, and in such way as to generate the heavy electric currents suitable for electric welding or forging, is mounted upon a suitable base or frame, as indicated.

"Mounted upon a frame in direct proximity with the dynamo machine, and preferably constituting a part of the frame or base carrying said machine, are the holding clamps to be used in the welding or forging operations, and with these clamps connection is made directly from the part of the dynamo generating the heavy electric currents. By thus combining the clamps and the dynamo machine the use of flexible or extended connections may be entirely avoided, and the electrical connection may, if desired, be a rigid one. I prefer, however, to make the connection from the dynamo to the clamp as follows: The armature conductors or cables, leaving the fixed armature, are bolted firmly against the contact plates p p, Fig. 1, which conveys the welding currents to the holding clamps H H.

"In Fig. 1 three separate armature coils are supposed to be employed. Of the six terminals, the three which at any time are of one polarity—say positive—are connected to one of the plates p p, while the remaining three are connected to the other plate. By the multiple arc connection shown, a current of very large volume is obtained. By revolving the field heavy currents of low potential are induced in the armature conductors c c c, which are bolted firmly against the contact plates p p', Fig. 1, in the manner shown at p'' in Fig. 2. One of the holding clamps is best insulated from the table or frame R, as indicated at I in Fig. 1. This is to prevent the passage of the welding current from the contact plate p' to the clamp H by the frame R.

"A front view of the holding clamps H H' is shown in Fig. 1, and an end view of one of them, H, in Fig. 2. They are made of heavy pieces of metal, so that they may conduct the large welding currents to the pieces to be welded and be sufficiently strong to allow considerable endwise pressure to be brought to bear on the pieces without danger of their slipping or bending. The clamps should be preferably of a form which will fit closely the pieces to be welded, so as to insure good contact, though comparatively small contact will often suffice to carry currents heavy enough to weld large pieces. Arrangements can also be made to allow free movement of one or both of the clamps.

"Referring to the drawings in Fig. 1, H' is a front view of one of the clamps, which is bolted firmly to the plate p, and is therefore immovable. The other clamp H, is movable, receiving its motion by the device D d. The bar d is bolted to H, but has a free movement about j, where it is loosely connected with a pivoted bar, T, pivoted at t. A screw spindle s, passing thorugh a screw hole in T, after the manner of a screw vise, and is provided at its other end with a ratchet wheel, with which a pawl is adapted to engage. When the lever A", carrying the pawl is brought down to a lower posi-

tion, the pawl acts to turn the screw *s*, which forces *d*, Fig. 1, and the clamp H toward H', this motion being rendered possible by the free movement of *d* about *j* and T about *t*, and the sliding contact of H with the plate *p*. The clamp H H', Fig. 1, are tightened about the pieces N N' by means of the levers A A'. These levers are secured to suitable rock shafts, 7 mounted in the base of the clamp and provided with eccentrics 8. The eccentrics 8 are embraced by collars 9, formed on the lower end of the rods 10, which pass at their upper ends through the top plate 12, of the clamp, and are there provided with the clamping ends *y y'*.

"The welding current is carried to the movable clamp H, Fig. 1, by the plate *p*, which has a sliding contact with H, as represented in end view in Fig. 2. The plate *c'* is bolted to the block *h*, which forms the base of H, and thus brings the clamp H into contact with *p*, to which half the conductors *c c c*, Fig. 1, are attached.

"In order to form a good connection from the plate *p* to the clamp H, one or the other of the plates *p c'* is provided with a gang of contact springs. By these springs good connection is formed, while at the same time permitting the one plate to slide upon the other in the manipulation of the clamp.

"The form of direct welding machine just described may be made self exciting by winding a sufficient number of turns of wire of suitable size in grooves cut in the armature core for that purpose, and connecting the terminals of these coils with commutator brushes resting against a suitable commutator placed on the revolving field magnet shaft of the machine, which suitable commutator is connected with the field coils of the machine."

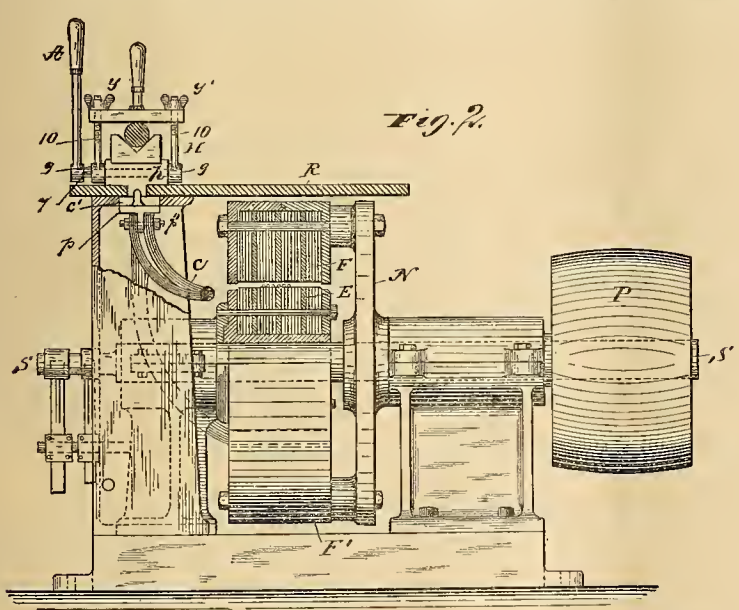


Fig. 2.

The specification then describes an arrangement wherein the exciting coils on the armature are wound in series; but the inventor does not limit himself to series winding. "By using wires of proper size the exciting coils may be wound in multiple and by changing the size of the wire to suit the conditions, the coils may be wound in multiple series. Arrangements to suit these conditions are well known to practical electricians, and need not further be dwelt upon here. It is also well known that such coils may be wound in series or on the core in several different ways, and the same is true of multiple arc winding and of winding in series multiple.

"In both of the arrangements herein described it will be observed that there is an absence of any commutator or collecting device between the dynamo machine source and the clamps of the apparatus, so that there is no break of continuity in the path of the heavy electric currents. This is a very important consideration in an apparatus for this purpose, and is attained by the apparatus described in my prior patents, where I have set forth the employment of an induction coil wound so that current of comparatively high tension on one circuit may generate the heavy or larger volume currents in a secondary wire, which is directly connected, without the intervention of any commutator or collector with the clamps.

"Still other arrangements or modifications may be made in my direct electric welding machine, and I do not limit myself to the apparatus described, but claim broadly, the invention of a welding machine which consists of a suitable dynamo machine for generating electric currents of great volume, in combination with holding clamps and devices for moving or manipulating the same, the whole forming one compact apparatus."

Aerial Photography.

During the war of the Rebellion, while the contending armies lay so long between Richmond and the Potomac, various efforts were made by northern engineers to obtain photographs from aerial elevations of the positions of the southern troops, says the Chicago *Tribune*. The attempts were made from balloons, but they were far from being successful. The art of instantaneous photography had not been perfected, if indeed it had been more than thought of, and the danger of exposure to the almost unerring rifle of the sharpshooter was so great that few were willing to essay the operation except upon the most favorable conditions of wind, weather, and situation. During the Franco-Prussian war, a few years later—particularly in the neighborhood of Paris—both French and German scientists undertook the enterprise of securing photographs of the opposing hostile camps and movements, but only with partial success. Since then photographic departments have been attached to nearly all the European armies, and numerous discoveries have been made in the management of balloons at elevations of from 5,000 to 10,000 feet.

M. J. Steffens, a photographer of Chicago, has recently secured letters patent for a new system of aerial photography which promises to be of value both for military and commercial purposes. It is a combination of instantaneous photography, controlled by electricity, and a hydrogen-filled balloon capable of supporting a weight of not more than thirty or forty pounds at an elevation of 8,000 or 10,000 feet. The balloon is composed of a film of pure rubber—something like that used in the manufacture of the little toy articles which street fakirs sell at a nickel apiece, and is filled with hydrogen gas made from the decomposition of zinc by sulphuric acid and passed through a bath of silicate of soda, so as to remove all traces of oxygen. To the balloon is attached the camera, the mechanism of suspension being arranged so as to allow of an angular or rectangular field of vision. Between the balloon and the camera is a wind fan, to reduce oscillation to a minimum, and to keep the camera in the desired position an ingenious arrangement has been devised whereby it will remain constant in the arbitrary relation in which it was placed to a large compass which was delicately adjusted to it. The camera is constructed somewhat upon the general plan of those used in taking photographs of horses running at full speed, and the delicate machinery for making the exposure and moving on the rollers the sensitized paper is manipulated from the ground by the operator through the means of an ordinary telegraph key. The cord by which the balloon is allowed to ascend has within it two fine threads of copper, which are not allowed to touch each other. On the ground, connection is made with a battery of three or four cells, or as many as may be needed. All that the operator has to do is to insert a roll of sensitized paper in the camera, adjust the angle of vision and the relation of the camera to the compass, attach it to the balloon, and then let it go aloft to the height required. A click on the key causes an instantaneous exposure; the machinery in the interior of the camera at the same moment begins to operate, and when the exposure is completed eight inches of the sensitized paper, on which the picture has been taken, is transferred to a second and smaller roller in the opposite side of the camera. The instrument is then ready for a second view, and so on until all the sensitized paper—a roll of forty or fifty feet—has been used, if so much be required. The apparatus is then hauled down, the gas expelled from the balloon, and everything used in connection with the experiments packed away in a box not much larger than an ordinary valise. The lens used is of the globular variety—a recent invention—and will take a picture without any disturbance at any distance beyond a focus of seventy feet. At an elevation of about 5,500 feet, the lens having a visual angle of 60°, the field of observation would be a circle having a diameter of one mile. If a greater field of observation were required at the same height, it would become necessary to use a lens having a greater visual angle than 60°.

The Book Table.

MUNICIPAL LIGHTING, by Fred H. Whipple; 260 pp., 6x9 inches, sold by WESTERN ELECTRICIAN, Chicago. $1.

The Detroit, Mich., common council some months ago took up the subject of the feasibility of the city's owning its own electric lighting plant, and appointed a special committee to thoroughly investigate the subject. Fred H. Whipple was made secretary of the committee, and MUNICIPAL LIGHTING contains the information collated by the committee during a comprehensive and exhaustive investigation of the subject referred to its consideration.

The chapter entitled "The contract or rental system," devoted to cities in America in which public electric lighting is done under the rental system, the systems in use, the manner of stringing wires and hanging lamps the hours lamps are burned, the area lighted, and special features of certain contracts, place a vast amount of information before the reader in succinct language and easily accessible form.

There is another chapter relating to underground circuits, which is of particular value, especially at this time when the undergrounding of circuits is a problem of weighty importance to many electric lighting companies.

To these two chapters we have given especial prominence, as we look upon them as having the greatest importance, but the value of the book does not lie in them alone.

To electric lighting companies, electricians and members of municipal bodies and residents of cities where electric lighting is done, or to be done, the book is commended—to the former for the information it contains in such ready reference form; to the latter class for the comprehensive information it presents in language freed as much as possible from technical terms and phrases.

THE DYNAMO, HOW IT IS MADE AND HOW TO USE IT.—Published by Fred M. Kimball & Co., Boston, Mass. 79 pp., 6x9 inches, paper covers. Price 50 cents.

This pamphlet is a compilation in printed form of a series of twenty minute noon talks by the author to the men in his employ. It is intended more particularly for plain, practical electrical mechanics. The first chapter engages in a discussion of electricity in general, and is followed by an explanation of technical terms. Dynamos and their parts and electric lamps are then taken up and described. General directions as to setting up, starting and operating electric light plants form the concluding chapter.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the cooperation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

PAGE.

A New Focusing Lamp, Illustrated 13
Electric Light in the Chicago Opera House 13
Charters for Rapid Transit Companies 13, 14
Sir William Thomson's Composite Electric Balance, by Thomas Gray, B. Sc., Illustrated 14, 15
An Automatic Ground Switch, Illustrated 15
American Electric Manufacturing Company 15
Chicago Electric Light Franchises 15, 16
Direct Electric Welding Machine, Illustrated 16, 17
Aerial Photography 17
The Book Table 17
Editorial 18
Telegraph Operators in Asia 19
An Electric Speed Recorder, by Geo. H. Barrus 19, 20
Western Electric Company's New Factory in New York 20
The Richmond Electric Road 20

DEPARTMENTS.

Correspondence 20, 21
The Electric Light 22
The Electric Motor 22
The Telephone 22, 23
The Telegraph 23
Electrical Patents 24

WE MUST ask to be excused for again calling attention to our typographical appearance; but we know that our efforts to improve still further so handsome a journal as the WESTERN ELECTRICIAN will be appreciated by both readers and advertisers—by the former because on the splendid white paper we are now using, type and engravings are brought out so handsomely, and by the latter because advertisements show up with such remarkable distinctness and attractiveness.

IN ANOTHER column is quoted the opinion of Dr. Richardson on electric executions. His experiments on animals have demonstrated that electric currents of large potential may merely stun and thus fail to effect death. He proposes as a measure of precaution that post mortem examinations be held. The English papers have been making all manner of fun of a proposition to hold a post mortem examination of a subject who is not dead.

IF THE Board of Electrical Control of New York, investigates the comparative values of the continuous and alternating currents for central station lighting as carefully and exhaustively as the Chicago Electric club, it has plenty of work ahead of it and need not adjourn for a summer vacation for lack of occupation; meantime the gentlemen of the board are respectfully referred to the files of the WESTERN ELECTRICIAN for a full and complete survey of the subject.

AS WE GO to press word reaches us of the imminent death of Hiram Sibley, of Rochester, N. Y., who was stricken by apoplexy July 9th. Mr. Sibley's name, almost unknown to the present generation of telegraphers, is identified with the foundation of the Western Union Telegraph company. In the early days of telegraphy in America, when independent lines were struggling for an existence, Mr. Sibley foresaw the great future of a single company whose lines should ramify the continent. In connection with other capitalists, he purchased the independent lines and absorbed them into the company now known as the Western Union Telegraph company. In this way Mr. Sibley laid the foundation of a large fortune. Mr. Sibley to this day, we believe, has retained a large financial interest in the company.

THE ordinances recently passed by the Chicago city council, giving several electric light companies the right to begin operations at once, will be allowed to stand without the mayor's approval. The mayor will not sign them because he favors the establishment of a city plant for illumination, yet he will not veto the measures because he favors competition with the gas companies in order that the cost of lighting streets may be lessened. It is said to be Mayor Roche's hobby to make Chicago the best lighted city in the world, and he thinks to accomplish this result the municipality must own its own plant.

PROF. ELIHU THOMSON'S direct electric welding machine, illustrated on other pages, marks another improvement in this most important branch of electrical application. This machine, as will be noted, consists of a dynamo for producing currents of large volume, but of low electromotive force, and suitable clamping devices for holding the pieces to be welded, the whole being compact and readily movable to places where the current necessary for the work cannot otherwise be obtained.

The great accomplishments in welding by electricity already noted in these columns have indicated the importance of the position in the industrial arts that this department of electrical application is to assume. For the forging or welding of the heaviest iron or steel shafts, or for the most delicate work on the jewelers' bench, electricity is equally well adapted. In the former case there is nothing lost in fuel in bringing a fire to the proper degree of heat, and in either case the electric current required is instantly available.

THE CITY COUNCIL of Chicago, at the meeting of July 10th., considered an ordinance originally proposed by Alderman Ernst limiting the charges of telephone companies to $75 per year. An effort was made to railroad the resolution through the council, but proved unsuccessful. The ordinance was referred to the committee on licenses. It is a matter for congratulation that no inconsiderate action was taken. The aldermen have not looked into the question and are not, or at least, should not be, prepared to vote on a question of such importance not only to a company but to the citizens generally. The aldermen apparently desire to follow the example of the St. Louis council, although as a usual thing that city is not supposed to furnish examples for Chicago. The aldermen should go slowly and investigate thoroughly before they act.

In this connection the views of Superintendent Phillips of the telephone company are worthy of attention. He seems to look at the matter in a fair light. "Before final action is taken," he says, "I think that a conference with representatives of the company will be sought and a frank statement of their side of the case be considered. I am inclined to think that the committee had in mind the case of St. Louis where the council passed an ordinance limiting the rental to $50. But that is only a part of the story. The St. Louis company is refusing to make new contracts at the $50 rate. The service with some of the patrons has been continued after the expiration of their old contracts, but it is with the stipulation that if the ordinance which is to be tested in the Supreme court is declared invalid the difference between the new and the old rate is to be paid to the company. I am not disposed to think that the aldermen desired to gouge the company. They were aiming to conserve the interests of their constituency. I will say I felt a little blue over the action. It has been my honest ambition to give Chicago the best telephone service in the country. I think that some attestation of the sincerity of this statement is shown by the money which the company has been expending. A switch-board costing $60,000 has just been put in, but that doesn't end the improvements that are being made and will continue to be made. I confess to having some enthusiasm in this work, and the action Monday night was a little like kicking a fellow when he's doing his best because he hasn't done more. Whether the company will continue the service if the ordinance is passed I am not prepared to say. In the language of Abraham Lincoln and many other statesmen before him—it will be time enough to build the bridge when we get to the river."

THE new focusing lamp invented by Mr. Warner, and shown on the title page, has an interest aside from that inherent in a new design of lamps of this pattern, inasmuch as it is a good illustration of how inventors have to overcome difficulties not at all apparent even after the most careful consideration of the circumstances of use, or in other words, difficulties that only use develops. Mr. Warner designed a focusing lamp which has met favor, and it would be supposed that on southern river steamers which wend their placid way over still waters with none of the pitching and tossing and rolling that vessels upon the great lakes or the seas encounter, any focusing lamp in which the carbons moved in a vertical line would answer the purpose; but it was found that southern river steamboat men from the very fact that they were not obliged to guard against the storms of great bodies of water were negligent in the matter of preserving an even keel, and loaded their boats without that careful regard for trimming paid by vesselmen in the port of Chicago for instance. Naturally enough, the carbons of the arc lamp were frequently thrown out of a vertical line and the lamp did not work as satisfactorily as it otherwise would. Mr. Warner, with this new experience, accordingly determined to make a focusing lamp that would work at any angle, and designed that shown in this issue. The experience of Mr. Warner can be matched, of course, in any line of manufacture, be it electrical or otherwise. It is a good illustration, however, of the long road the idea frequently has to travel before it reaches embodiment in practical form.

GEO. H. BARRUS, a well-known mechanical engineer of Boston, Mass., described before the American Society of Mechanical Engineers in semi-annual convention at Nashville, Tenn., an electric speed recorder, which as will be seen by the table accompanying his article resulted in securing data that would hardly be possible except through the medium of electrical application. In other words, the cumbersome and tedious method of applying an ordinary mechanical speed counter could not have given him the accurate results attained by the use of the electrical instrument.

In No. 13, Vol. I., page 115, of the WESTERN ELECTRICIAN, Prof. H. S. Carhart described results attained in the simultaneous measurement of the respective speeds of an engine and dynamo through the aid of a velocimeter, an invention of F. W. Cushing, an electrician well-known in Chicago and the West. With the article was given an illustration of the record made by the instrument upon a paper tape. In the illustration were shown a succession of short dashes representing the record made by the dynamo pulley, a succession of longer dashes representing the record made by the engine pulley and between these two lines of dashes, a succession of dots of which 150 were made in a second of time. The record thus made was complete, and any variations in speed of either engine or dynamo could be detected by comparison of the record of one with the record of the other while the time element was also presented for the reference of either record to it.

These two instruments show the tendency on the part of mechanical engineers toward attaining more accurate results in their observation of the speed of engines and dynamos and illustrate the possibilities inherent in electrical apparatus.

Telegraph Operators in Asia.

The following account of the telegraph service in Persia is taken from Thomas Stevens' article in the New York *Sun:*

It was a wild, barbarous country, about the Turko-Persian border, inhabited chiefly by nomad Koords, and I missed even the occasional welcome company of the Turkish telegraph line. Its disappearance seemed like casting off the last strand of western civilization. At that time I hardly expected to see another telegraph line until I should reach Japan, my intention being to reach the Pacific through Turkestan and China.

Suddenly one day when nearing Tabreez, I saw away off on the desert a sight that made me blink and rub my eyes to make sure that it was not a mere optical illusion I was looking at. The deserts of Persia are famous for producing bogus objects—mirages of lakes and waving palms, of lovely castles and similar fascinating scenes; but this time it was none of these. Miles away to the north, seemingly suspended in mid air, was a league-long row of telegraph poles, straight as a die, even as the pickets of a garden fence.

As I drew nearer the line assumed a more definite form. Its marvelous symmetry, I then discovered, was not the enchantment of distance, but a solid reality in English iron, with the name of the contracting firm stamped on the poles, every pole tapering from a circumference of twenty inches at the bottom to six or eight at the top, and across the dead level wastes of the Persian plains set up as evenly and perpendicularly as they might have been in Hyde Park. It is worth noting, perhaps, by the way, that the English always take particular pains to have everything of this kind very superior in the east; it is a perpetual source of wonder and admiration to the natives, a standing advertisement of England's wealth, power and ability to the multitude who have no other way of learning.

From Tabreez I was able to follow this infallible guide into Teheran. Often I could see it stretching ahead of me mile after mile, the poles so even that they seemed not to vary an inch, and disappearing in the heavens at the farther end by the curious legerdemain of the desert. The æolian music of its triple wires as the desert breezes played through them, and the messages flashed past from India to England, from England to India—how companionable it was, that bit of civilization in a barbarous country, only those who have been similarly placed know.

During my stay in Teheran I became quite intimately acquainted with the staff, not only in the capital, but throughout all Persia. There are many curious and interesting phases of life connected with the telegraph service in such a country as Persia that are unknown here. Its alignment and its working staff represent a narrow streak of western civilization through all that part of Asia. Men two thousand miles apart, who never saw each other in their lives, are nevertheless well acquainted. The lone Englishman at the little interior control station at Dabeed is kept informed from day to day by his chums at Teheran of the doings of the European colony there.

Teheran, Ispahan, and Shiraz are the three favorite stations in Persia. Operators are rewarded for good service by being stationed at these points, or disciplined for misconduct by being assigned to some lonely control station, where the only society is a few ragged villagers, and their station a mere mud hovel. Dabeed, about midway between Teheran and Bushire, is considered the worst station in Persia. The extremes of heat and cold in Dabeed are intense. From many degrees below zero in winter and raging storms like blizzards, it gets so hot in summer that the operator often sits at his instrument up to his chin in a tub of water. None of the cooling appliances that make life tolerable in India are available here.

The Ingiliz telegraph-jee is quite an important personage in Persia. Outside of Teheran and Bushire, he is the sole representative of Europe. He is a sahib, whose salary often exceeds the income of the Persian prince or governor of the town. He has several servants, and keeps the showiest riding horses in the town, vieing in the matter of horseflesh with the local prince, with whom he is always on very good terms. He and the prince invite each other to dinner; not a day passes but the prince comes and smokes a kalian or two in the telegraph thana, and in the evening they sit beside the steaming samover and smoke and drink tea. The prince sends his friend, the telegraph-jee, presents of fruit, or a pheasant now and then, and when the line inspector comes along and leaves with the Englishman a few bottles of choice Cruiskeen Lawn, the prince knows he will not be overlooked.

The mollahs and seyuds and khans and leading merchants—these, too, are all friendly, as a general thing, to the Feringhi. He is the one relief from the monotony of daily life to them, a speck of human interest upon which to center their Oriental curiosity.

It is often a remarkable change for the young Englishman. From an unambitious berth in England, wages a pound a week, he finds himself in a month or two hobnobbing on equal terms with Persian princes, with twice as much money to jingle as the prince, and riding the finest horse in town. In addition to a large salary, inducements are held out to him to qualify himself for preferment. A sum equal to three months' salary is paid him for passing an examination in Persian. Five hundred pounds are offered as an inducement to qualify for services in India. For all these advantages about the only sacrifice he has to make is of a social nature.

Food is cheap and plentiful, and in the larger stations almost everything can be found in the bazaars. Some of the men marry and settle down in the service; they obtain wives from England, or marry the maid servants at the legations in Teheran. One or two have married American women; but by so doing the "telegraph sahib" loses caste, much as a man does out west by marrying a squaw. He loses caste in the estimation of his comrades, the Persians, and also with the Americans themselves at heart, although they consider the capture of a sahib very advantageous.

Everything is now so thoroughly equipped and organized that the telegraph service runs smoothly and efficiently; but this was far from being the case at first. The difficulties were a long way from being overcome when the line was put through. For some years it was almost impossible to keep communication open between Teheran and Bushire. Here for nearly a thousand miles it follows along the greatest caravan route in Persia. The charvadars and camel men regarded the long lengths of nice strong wire strung all along their route almost in the light of a special dispensation of Allah, sent to their favored country so that they might obtain all the material they wanted from time to time to mend their ramshackle pack saddles, chains and harness, without paying out any money.

All summer long thousands of camels and pack mules are constantly employed along this route, and the caravan people used to render the line well nigh worthless. Whenever anything broke that could be mended with wire, the charvadar would simply shinny up a telegraph pole and help himself. In a day or two, perhaps, something else would fall to pieces; but it mattered little to the charvadar, for an unlimited quantity of good English telegraph wire was always to be had for the trouble of climbing a pole.

Next to the charvadars the wandering tribes were the worst depredators. The nomads of Persia are much given to embellishing their charms of person by means of thick wire bracelets. Copper or silver wire is their preference, but they have no objection to bracelets of baser metal, especially if they can obtain them without pay. To stretch a telegraph wire through their country was about the same thing as placing a pot of jam where it can be easily reached by a boy. Nomads who had caught on went strutting about the country wearing a wealth of telegraph wire bracelets that made the eyes of their less lucky tribes bulge with astonishment.

Finding that they could be obtained for nothing by merely climbing up the Ingliz poles and hacking off the wire, the popularity of the new style bracelets spread far and wide among the Eliantes, Susmanis, and Bactiaris. These unsophisticated children of the desert, for a time, outdid even the caravan men. Ambitious young nomads thought they saw in the unlimited quantities of telegraph wire an opportunity to largely increase their wealth, and they began to carry the bracelets into the more remote regions as articles of commerce.

All this the English government stood patiently, hoping that time and the employment of numerous native linemen would eventually put a stop to the depredations. The caravan people, however, finding that they escaped punishment, grew more and more enterprising and aggressive. They were not slow to discover in the thing they found so profitable, sources of amusement to boot. They took to shooting at the insulators for wagers, and clipping the wires with bullets for sport.

Another form of recreation was to make a mark up near the thin end of the cast iron poles, and stand off so many paces and shoot at it. They used to gamble on the number of shots it would take to crack the pole, and bring the upper part, cross-trees, wires, and insulators, down to the ground. This was, of course, rare fun for the Persians. But for those who had to bring iron poles from England, and pack them on camels hundreds of miles over the deserts, it was not quite so funny.

The English finally had to appeal to the shah to protect the line. "Very good," said the king of kings, blandly, "it shall be stopped." Orders were sent out to cut off the hands of people who were found wearing telegraph wire bracelets. Among these unfortunates were the two Eliantes mentioned at the beginning of this paper. Equally effective punishments were dealt out to the caravan people. This had the desired effect, and to-day the telegraph wires are as safe in Persia as in any country.

An Electric Speed Recorder.[1]

By George H. Barrus.

In the paper read by W. R. Eckart, at the Philadelphia meeting a description was given of an instrument for recording speed constructed on the principle of the chronograph. Recent experiments of the writer on certain steam engine governors, required the use of an instrument of similar character, and an apparatus was arranged on the following plan:

The apparatus consists essentially of an instrument similar to a Morse telegraph register, in which there are two recording pens, each working independently by an electro-magnet. The record is made upon a paper ribbon moved by clock-work at a speed of about two and one-half feet per minute. The magnets are operated by the alternate making and breaking of the electric circuits in which they are placed. In one case the circuit is made and broken by the oscillating movement of the escapement wheel of a clock, and this occurs 120 times per minute, or once in a half second. In the other it is done by the revolution of the engine shaft, which is arranged so that during half of the revolution the two ends of the circuit are in contact, while during the remaining half the circuit is broken. The records consist of two lines of short indentations or dashes, made in the paper ribbon, and these lines are parallel to each other and five-eighths of an inch apart. The time record is made up of dashes about one-eighth of an inch long, and one-eighth of an inch apart, that is, about one-quarter of an inch from center to center. The dashes making up the speed record are about one-sixteenth of an inch long, and, in the case under consideration, about half as far apart as those of the time record.

The number of revolutions which takes place during any desired period of time is determined by drawing perpendicular lines through the centers of those dashes which mark the beginning and the end of the interval, and counting the number of speed dashes and fractions which lie between these lines. The record appears to be reliable to as small a fraction of revolution as one-tenth.

This instrument operated satisfactorily at a speed of 300 revolutions per minute. To show the utility of such an instrument, the record of one test is appended, which was made to determine the rapidity with which the governor operated when the engine was first attaining its normal speed, starting from a state of rest, the throt-

[1] Described at the convention of the American Society of Mechanical Engineers at Nashville, Tenn., May 8–12, 1888.

tle valve being wide open and the engine carrying simply a friction load. The first part of the record shows the indications made when the engine was working at normal speed. The throttle valve was then closed for a time to allow the speed to become reduced; then it was opened wide and the governor allowed to take control. The record shows the number of revolutions made for intervals of two seconds during all this time.

Time.	No. of revolutions indicated by recorder.	Difference for 2 seconds.	Remarks.
4.18.55	802.4		
19.05	845.9	Av. 8.7	
15	889.4	Av. 8.7	Throttle shut at
25	926.2	Av. 7.36	[4.19.15
27	932.2	6.	
29	937.7	5.5	
31	942.7	5.	At 4.19.30 open
33	948.8	6.1	[throttle wide.
35	956.2	7.4	
37	965.	8.8	
39	973.7	8.7	
41	982.5	8.8	
43	991.3	8.8	
45	1000.	8.7	
47	1008.6	8.6	
49	1017.3	8.7	
51	1026.1	8.8	
53	1034.6	8.5	
55	1043.4	8.8	

Western Electric Company's New Factory in New York.

The rapidly growing business of the Western Electric company of Chicago demanded some time ago the erection of a new factory in New York city. Work has already been begun on the structure. It will make it possible to employ a force for manufacturing more than double the number now engaged, and will increase the facilities of the company in every department.

The new factory will be located at the corner of Thames and Greenwich streets, fronting 120 feet on the former street and 82 feet on the latter thoroughfare. The building will be a handsome structure ten stories in height. The street fronts will be light salmon-colored brick, with stone and terra cotta trimmings. Fireproof throughout, the building will be constructed substantially, and when completed will be one of the finest buildings devoted to electric manufacturing in the country. The floors will be built on brick arches, with iron beams. The elevators and stairways will be inclosed in brick shafts.

The main entrance will be on Thames street, and near the entrance will be the passenger elevator running to the offices. The entrance for the workmen and the shipping rooms will be on Greenwich street. Two elevators for freight will be located in this portion of the building. The general arrangement of all the floors will be about the same. On the basement floor will be located the engine room, boilers, storage room for coal, and brass and nickel plating rooms.

The electric light plant will be on the first floor. The plant will consist of about 200 arc lights and a considerable number of incandescent lights. The retail store, the packing and shipping rooms, and the entrance passages are on this floor.

The second floor will be devoted to woodworking entirely.

The third floor will be used for general storage, and as a stock room.

The next five floors will be devoted to manufacturing; the arrangement has not yet been determined upon.

The ninth floor will be divided into inspectors' rooms and general offices

The foundations of the building are about half completed, and the contracts for the masonry, iron work, carpenter work, and stone and terra cotta work have been let. It is expected that the factory will be completed ready for occupancy next spring. The cost will be about $275,000.

A certificate of incorporation has been granted to the Chicago Insulating & Construction company of Chicago. The capital stock is $250,000. The company will conduct a general manufacturing business and deal in insulating materials and supplies. The incorporators are E. B. Palmer, E. A. Mulford, and T. M. Hunter.

The Richmond Electric Road.

When the Union Passenger Railway company commenced, one year ago, to lay its tracks there was much speculation in the minds of the public as to the result of the electric experiment, says the Richmond, Va., *State*. Electric car lines were in operation in other cities, but only on a limited scale. No city in the world had as much as twelve miles of track, and no electric company, we believe, had experimented with grades so steep as those on the electric route in Richmond. Many persons had faith in the final triumph of the car electrician, but the majority doubted. A few cars may be operated, but thirty or forty never. The cars may run well enough on the levels, but they will never climb the hills or get around the sharp curves. These were remarks made by many practical men. Some went so far as to say that the whole enterprise would collapse before the line was completed.

But what do we find to-day? The Union Passenger, Sprague system, run thirty or forty cars, all that could be supplied by the manufacturers at the start, and with the fast speed at which these cars move, the public has been fairly accommodated. The summer cars seat fifty, but as many as one hundred persons have succeeded in squeezing into one car. On Sunday last over 13,000 passengers rode on the Union line, and on Monday over 10,000. Up the steep grades and around the sharp curves the cars move with amazing facility. The double track extends to the West End as far as Hancock street, but from that point to the New Reservoir park a single track, with a number of turnouts, is made to suffice for the present. A double track for the entire distance would be more satisfactory both to the company and the public, and a double track will be laid before another year.

The electric service is a pronounced success; there are no longer any doubters.

The route of the Union railway was marked out with singular economy; that is, with a view of touching as many different sections of the city and suburbs as possible. St. John's church, which all visitors to the city wish to see; Marshall park, Chimboraza park, and the northern side of Church hill are reached by the electric line; the thickly settled section of which North Seventeenth street is the thoroughfare is reached by the electric line; nearly all the hotels are either on the line or near it; the cars pass the custom house and Capitol square; the principal places of amusement are on the line; the belt known as Jackson ward is traversed by the line; Main street is only a square from the line between Seventh street and Twenty-first, and Broad street is only two squares from the line between Seventh and Hancock streets. The line crosses Grace street near Richmond college, and thence runs directly to Hollywood, and past the Old Reservoir to the New Reservoir, about a mile beyond the city limits.

But with this popular route just sketched the city railway, with its Main street line from Fulton, and its Broad street line, and with its extension to the main entrance of Hollywood, and with its line to the New Reservoir along the Main street road, affords a convenient service to thousands of our citizens, who could not well do without it. The fact is Richmond is a very large city, and with her twenty-five or thirty miles of track—including the Manchester line—there is yet room for further extension; a line, for instance, from Gamble's hill to the northern terminus of Third street is needed.

But what the people are to be congratulated upon just now is the privilege granted by the council to the City railway—the old horse line—to use the electric motor. It is said that work will be commenced without delay upon the Main and Broad street lines, and that they will be supplied with electric cars in time for the exposition. The ordinance very properly provides that in the event of trouble arising from the use of overhead wires the wires will have to come down. But the city engineer and others qualified to investigate the matter anticipate no trouble.

Richmond ranks as a prominent commercial and industrial city. No city in the south can boast of more wealth than Richmond. But Richmond has been too conservative in many respects, and these electric enterprises have done a wonderful work in giving a hustling air to the city. Modern Richmond is being advertised throughout the world as never before.

"Ex-district attorney Sullivan, who has just returned from camp, was busy all day telling friends whom he met how ex-Coroner Levingston, who was one of the party, detected a thief," says the San Francisco *Post*. "When we started I noticed," he said, "the doctor was encumbered with a large box containing his instruments, and I was going to advise him to leave them at home, but on second thought it struck me that they might come in handy to mend harness in case of a break down. The second day in camp we noticed that our stock of provisions was fast disappearing. The finest canned and wet goods vanished, and the party began to look upon each other with silent suspicion. Finally, as a famine was threatened, a meeting was called, and each and every man pleaded not guilty. No one up to that time suspected the honest country lad we had engaged as a servant. He was questioned and also entered a prompt and emphatic disclaimer of guilt. We all believed his protestations of innocence except Doc Levingston. 'Gentlemen,' said he, 'somebody in the party took those provisions, and I propose to find out who. I have here a thief detector,' pulling out his electric battery and winking at the crowd. 'If there is a thief among us this will point him out.' Every man took his turn at the battery. The boy watched the performance in wonderment. He had never seen such a queer arrangement as an electric battery before, and, as everybody who touched the coils escaped without harm, he stepped bravely to the front when it came his turn, and took hold. A sudden change came over him. The doctor had turned the battery on full force, the victim gave a yell of pain and horror, and fell to the ground screaming: 'Save me, save me. I took 'em, but I'll never do it again.'"

CORRESPONDENCE.

New York Notes.

NEW YORK, July 5.—It is a matter of history that it became necessary to adopt extreme measures in Chicago in order to enforce the underground measures required in order to comply with the city ordinances. History appears to be repeating itself, and although no wires have as yet been cut in this city, the authority of the law has been exercised in an endeavor to enforce the United States Illuminating company to recognize the power of the Board of Electrical Control. The position taken by the board is an arbitrary one, it being that this company is in contempt by reason of its non-compliance with the regulations laid down, but more probably because it has shown no disposition to either make a beginning or treat the recommendations of the board with proper respect. This is strikingly apparent because none of the other arc lighting companies have placed their wires in the conduits. The police were notified to arrest any person attempting to trim the lamps of the United States company within certain districts of the city. No arrests were made, however, as the company simply suspended the service, violating its contracts with private consumers. No street lights were involved, as was generally understood, so that on the night of July 3d, instead of the streets being in darkness, the service was performed as usual by the Brush company, which has all the public lighting within the proscribed district. It is, of course, expected that the matter will be fought out in the courts, and it is very probable that it will be found that the company in question has good grounds for believing that the enforcement of the underground law can be postponed for a long time unless it is considered a better line of policy to surrender.

Since the foregoing paragraph was written, Corporation Counsel Beckman has brought suit against the United States Illuminating company to compel them to use the subways and remove their overhead wires.

The Daft company has completed the equipment of the street railway at Meriden, Conn., with eleven motor cars, and the line will be operated by electricity on and after this date. The contract was signed on the 15th of March to be completed in four months, so that it is in fact ready ten days ahead of time, and might have been still earlier but for delay in the delivery of the cars to be fitted up.

The telegraphers are again showing signs of uneasiness, and have issued a general circular to the craft inviting them to join the brotherhood, it being considered an appropriate season during a lively political campaign to perfect their organization while so much interest is being exhibited in the welfare of the working men. It does not appear that anything more serious will come from the agitation than the bringing of the subject to public notice. The telegraphers, although their peculiar handicraft places them in the highest rank of skilled labor, are not chronic strikers, and their past experience in protective organizations is not very encouraging. They are desirable allies, however, and are considered a very important branch of the knights of labor, whose leaders fully recognize the importance of their calling.

Judge Andrews of the Supreme court granted an injunction on Tuesday against the East River Electric Light company, restraining them from erecting poles for their wires in front of the premises of Edward Ridley & Sons on Grand street. This company uses the Thomson-Houston system, and has recently secured contracts for lighting the streets on the east side of town.

At the last meeting of the Board of Electrical Control an application was made by Edward Lauterbach, representing the conduit company, to put down an experimental section of subway for the purpose of making a practical demonstration of the Johnstone system for the underground distribution of electrical conductors. This is a feature of the system which was introduced on Chestnut street in Philadelphia and to a limited extent in Chicago. The matter was referred to the engineer and expert of the board for investigation.

Following the example set by the Chicago Electric club, the Board of Electrical Control has taken up the question of "Alternating *vs.* continuous currents," and the next meeting of the board will be held on Monday in the lobby of Wallack's theater, in order to accommodate the crowd which it is thought will be attracted by the discussion. This subject has been brought into prominence, so far as the board is concerned, by a communication which appeared in the columns of the *Evening Post* of this city, signed by Harold P. Brown, in which the writer took extreme ground against the introduction of high tension alternating currents for incandescent lighting in New York. He also suggested certain rules for adoption by the board, and has since challenged those who did not agree with his views to meet him in debate before the board. If they should all

attend the meeting, it will probably be necessary to adjourn to the main body of the theater. P.

Kansas City, Mo.

KANSAS CITY, MO., July 6.—Superintendent W. W. Smith of the Kansas City Telephone exchange, said to the WESTERN ELECTRICIAN representative in regard to the request of some telephone subscribers of the mayor to take steps toward forcing a reduction of the charges for service, that if this matter came up before the people seriously he wished it treated in a spirit of fairness and not as a question of law. If it should come to the latter alternative, however, it would be seen that the city fathers have no right to interfere with the prices asked, and have only the right to dictate to the company as allowed in section 888 of the laws of the state. The Missouri and Kansas Telephone company is organized and maintained in accordance with section 879 of the laws of the State, which reads as follows:

"*Privilege in Constructing Lines.*—Companies under the provision of this article for the construction and maintenance of telephone or magnetic telegraph lines are authorized to set their poles, piers, abutments, wires, and other fixtures along and across any of the public roads, streets or waters of this state in such a manner as not to incommode the public in the use of such roads, streets, and waters."

It will be shown in the following section what power the common council has over the company and to what extent they may dictate.

"SECTION 888. *The Mode of Construction may be Directed by Whom.*—The mayor and aldermen or board of common council of any city or the trustees of any incorporated town through which the lines of any telephone or telegraph company are to pass may by ordinance or otherwise specify where the posts, piers or abutments shall be located, the kind of poles used, and the height the wires shall be run."

It is to be hoped that no measures will be taken to set the price for the company to charge, as that would mean the closing of the company's offices here, and leave the city without a fire alarm system. D.

KANSAS CITY, MO., July 9.—The matter of putting the telephone, telegraphic, and electric light wires, underground, will soon be again brought to the attention of the council. There are two ordinances for franchises for conduit systems now in the hands of the public improvements committee, but neither has been considered. They were referred to the committee over two months ago when eastern capitalists were trying to get a franchise for a system and immediately after one ordinance had been vetoed by Mayor Kumpf.

"It is high time that some steps toward having the wires put underground were taken," said Mayor Kumpf to-day. "It is a thing that when begun will take a couple of years to complete, and we should therefore get started on the matter. My idea is that a committee of the council should take it in hand, visit the cities where conduit systems are in use, examine the systems and select whichever they consider the best. Let the engineer accompany the committee and all make a thorough investigation. Then let a franchise be granted to some person or corporation; but the city's interests should be well protected in the ordinance."

Naturally, the electric companies are, as a rule, opposed to this movement, and will fight it.

But the question of putting the wires underground is not the only thing bothering the telephone company. A movement is on foot that the officers of the company are inclined to call a movement to put the entire company under the ground. It is a demand for a reduced rate, growing out of the agitation at St. Louis. There the council passed an ordinance cutting the rates from $100 to $50 a year. The Bell company of St. Louis objected, and the case is now in the State Supreme court and will be decided at the October term, the question being whether the city has the right to interfere with the rates of the telephone company. Kansas City thinks, of course, that she should not let St. Louis get ahead of her in any matter, and is agitating reduction in the Kansas City rates from $72 to $50, at least. The mayor has signified his agreement with the movement and has notified the city counselor to investigate the law in the case. The mayor has also called the attention of the council to the matter and asked it to pass an ordinance reducing the rates. The city counselor has reported that there is sufficient law for the council to base its reduction ordinance upon. The Inter-state Telephone Manufacturing company has offered, in case the rates are reduced to $50, and the Missouri and Kansas company abandons the field, to put in a system at the low rates mentioned.

There are several hundred men in this city, not to speak of the young ladies in the offices and at central, who spend all their time in electrical occupations. All of them are bright and pleasant fellows, and many of them spend much time in the study of electricity. It has been suggested that it would be of great mutual benefit and enjoyment to organize a club out of this material and a number of the leading electricians of the city are talking the matter over in a way that will undoubtedly have material results.

The Western Electric Construction company has established a storage house at Fort Scott, Kan., and is rapidly shipping the supplies in there for the equipment of the Fort Scott electric light plant. The company's Kansas City agency has also been filling the contract lately for two dynamos of 600 light capacity for the Elms Hotel at Excelsior Springs, Mo.

Harry M. Cutler, representing the Loomis Electric Manufacturing company, has settled down to hard work after getting well acquainted, and is leaving no one in ignorance of the value of the light he represents.

Paul W. Bossart, of the Inter-state Electric Light company, states that the plant being put in by the company at Missouri Falls, Iowa, will be in operation next week at the farthest. The company will also put in accumulators at Fort Scott, Kan., as soon as the electric light plant there is ready for them. The work on the Inter-state's central station in the Keith & Perry building, in this city, is proceeding slowly on account of the progress of the building, but that section of the city is being thoroughly wired for the future operations.

The American Electric Light company is enlarging its station and putting in two additional 50 light machines. A.

Indianapolis Items.

INDIANAPOLIS, July 6.—The county board of equalization has just concluded its work and fixed among others the following taxable values: American Bell Telephone company, $43,900; Central Union Telephone company, $25,130; Electric Light Gas Heating Illuminating company, $50,000; Brush Electric Lighting company, $33,643; Indianapolis District Telegraph company, $6,000; Jenney Electric Light company, $25,000; Western Union Telegraph company, $71,000.

The city council at its regular session Monday night amended the charter of the Dudley Street Railroad company so they could use either cable or electric motors. The committee who had this matter in charge also recommended several other changes which were adopted, leaving the matter in such shape that the officers of the company do not know whether they can go ahead with the line or not. They are given thirty days to accept the charter and must begin work in ten days. There is also another company known as the McNeal company who claim to have $300,000 in the bank, and are ready to begin laying track as soon as they are granted a charter. They will use electricity for power.

Bids for city lighting were also opened and the following companies were bidders: The Brush company of Cleveland, Thomson-Houston, the Fort Wayne Jenney and the Indianapolis Gas Lighting company. The last named company are lighting the city, supplying 2,644 posts for about $70,000 per year. Their bid was as follows: For the present number of lamp posts 2,540 hours $39,660, 2,740 hours $40,982, 3,750 hours $48,987. The Brush company bid six hundred 2,000 candle power lamps per annum, 2,540 hours $48,600, 2,740 hours $51,000, 3,750 hours $58,800. The Jenney company bid for the same number of lamps and hours, $37,500; $40,000; $42,500. The Thomson-Houston, $52,200: $54,000; $57,000. Six hundred lights was the number the city engineer estimated sufficient to furnish an amount of light equal to that of the present number of gas lights. The companies who bid estimated 500 lights of 2,000 candle power each, sufficient to furnish as good or better illumination, and bid as follows: Brush, under the present schedule of 2,740 hours each per annum, $42,500; rate per lamp, for additional lamps, $85; Jenney, $31,250 and $62.50 for each additional lamp. Thomson-Houston, $45,000, and $90 for each additional light. In addition to the foregoing the Jenney made a proposition to put up as many lights throughout the city, regardless of the number of lights required in illuminating the city, to the entire satisfaction of the council and aldermen, for the following amounts: 2,500 hours per annum, $39,000; 2,740 hours per annum, $42,000; 3,750 hours per annum, $45,000. The Jenney company further gave the city the first option on the purchase of plant. All the bids were based on a three years' contract and each was accompanied by a $5,000 certified check. The matter was referred to a committee to report on at the next regular session, Monday night next. M.

Kansas Towns.

HUTCHINSON, KAN., July 6.—The Hutchinson Light, Water and Telephone company will probably increase its plant this fall owing to the rapid growth of the city. This company can furnish water, electric light, either arc or incandescent, and telephones. The plant was constructed and is now run by Mr. Beebe to whom great credit is due, as the whole plant has given perfect satisfaction since its installation.

The main wires leading to the telephone exchange at Hutchinson were blown down during the recent heavy storms, cutting off nearly all subscribers. The company expects to be in operation by July 15th running a two hundred wire cable underground from the main to the exchange.

The Great Bend Electric Light company of Great Bend, Kansas, will be in operation by July 10th. M.

St. Louis, Mo.

ST. LOUIS, MO., July 7.—The Lindell Railway company are having another electric motor car built. The management prefer to make some further experiments before adopting the storage battery system. The president thinks the road can be operated on seven-ninths the expense by means of electric motors.

The St. Louis Electric Motor company have opened an office at 506 Olive street. The station is located at the corner of Third and Locust streets. This company, under the management of D. W. Gurnsey, are handling the Sprague motor and are meeting with merited success.

Rose & Rein, proprietors of the Franklin Electrical works, have sold all of their plant and good-will to P. F. Burns, who will continue to manufacture the electrical specialties so ably pushed by Rose & Rein. The shop will remain at the old location, corner of Second and Locust streets.

F. G. Waterhouse has been in the city for a few days. The Laclede Gas company has not yet decided on a system.

An arc circuit was opened in a very curious manner here on the evening of the Fourth. A large sky-rocket was sent up from in front of a building. The rocket in its rapid ascent struck the arc light wire and severed it; the result being the extinguishment of about forty lights in the heart of the city. B.

Arkansas' Progress.

LITTLE ROCK, ARK., July 8.—The Little Rock Electric Street Railway company completed its line in this city last week, and celebrated the event by giving a big excursion to the citizens and any one else who would accept the company's hospitality. It was attended by the officers of the state, county and city, and by a large number of guests from different points in the state and country. The line is four miles in length, and passes through the best property in the city.

CAMDEN, ARK., July 8.—J. B. Friedham is endeavoring to organize a company here for the establishment and operation of an electric light plant.

The Camden Street Railway and Telephone company has been organized for the purpose of constructing a street railway and establishing a telephone system. B.

St. Joseph's Electric Railway.

ST. JOSEPH, MO., July 8.—The Union line began making regular trips last week with motor cars from New Ulm park to the City hall. Two cars were put on, and they worked as smoothly as any rapid transit machinery ever used. A picnic at New Ulm park attracted a large number and thus gave the cars an unusually good test. Much doubt had been entertained of the ability of the motors to carry heavy loads around the curves. This doubt was dispelled on the day of the trial. A 14-foot car, loaded to the limit, was whirled around the curves at a rate that made passengers hold their breath. C.

Fifty-two Goats Killed by Lightning.

EL PASO, TEX., July 7.—On the night of the Fourth this city and vicinity was visited by a thunder storm which, in the amount of electricity discharged, was unprecedented in this section. One of the peculiar manifestations of the lightning was in the striking of a tree under which a flock of goats had taken shelter. Fifty-two of the animals were killed, but only a slight trace of the lightning could be noticed on the tree. D.

Colorado Cullings.

DENVER, COL., July 5.—The Westinghouse plant at Denver is no doubt one of the finest incandescent plants in the country. It is now running upward of 6,000 incandescent lights.

The city of Pueblo, Colo., has given a contract to the local electric light company for thirty-six more arc lights. D.

The Fowler Insulating company of Chicago, has been incorporated, to make, apply, and sell insulating and fireproof materials. The capital stock is $150,000. The incorporators are Preston B. Rose, Thomas Connelly, and Frank A. Fowler.

THE ELECTRIC LIGHT.

The Heisler Electric Light company in St. Louis now employs 200 men.

The Western Electric company of Chicago has sold a twenty-five light arc plant to the Santa Clara, Cal. Development company.

Rochester, Minn., is building its own electric light plant and gas works. About 400 incandescent lights have already been contracted for.

The Kansas City Electric Light company has ordered a plant of 1,500 incandescent lights of the Thomson-Houston company of Chicago.

A 30-light arc machine has been ordered of the Thomson-Houston company of Chicago, as an increase to the plant of L. B. Townsend, at Ionia, Mich.

The electric light company of Trinidad, Cal., has ordered as an increase to the present plant, a 35-light machine of the Thomson-Houston company of Chicago.

A 30-light incandescent dynamo has been purchased of the Thomson-Houston company of Chicago, for use in the United States lighthouse district at Memphis, Tenn.

The electric light company of Madison, Wis., has ordered of the Thomson-Houston company of Chicago, a new 50-arc dynamo, as an increase to the present plant.

The Thomson-Houston company of Chicago, will install a 70-light arc and 1,000-light incandescent plant for the Pine Bluff Water & Light company, of Pine Bluff, Ark.

The Mohawk Valley Electric Light company, of Utica, N. Y., has been incorporated, with a capital stock of $35,000. C. K. Grannis, D. O'Connell and others are corporators.

The Residence Electric Light company, of East St. Louis, has been incorporated with $25,000 capital stock. Those interested in the company are W. L. Hill, Charles Sutter, and C. H. Holmes.

The Knoxville Electric Light & Motive Power company, Knoxville, Ky., has been incorporated. The incorporators are J. M. Thornburg, J. C. Duncan, Geo. Andrews, W. H. Simmons and E. F. Wiley.

The Electric Light, Power & Fuel company of Coldwater, Mich., have closed a contract with the Western Electric company, of Chicago, for a 50-light plant to be erected and in operation as soon as possible.

The Thirty-first street Electric Light Power company of Chicago, has been incorporated with $50,000 capital stock. The incorporators are, J. J. Shimers, J. J. McEvoy, S. F. King, and Owen O'Neil.

Plans have been prepared for a three-story brick building, eighty feet front on Townsend street, and 275 feet on Clarence place, San Francisco. The building is intended for the California Electric Light company.

The electric light plant installed by the Western Electric company of Chicago, at Dunkirk, N. Y., was started on the evening of July 4th, and the brilliant illumination formed one of the features of the day's celebration.

The Charleston Brush Light company of Charleston, Illinois, has been incorporated with a capital stock of $15,000. The corporators will deal in motor and electric apparatus and operate motor and electric plants. The incorporators are, E. L. Link, E. Cadle, and C. E. Winter.

The Gaston Electric Headlight company of Sparta, Ill., has been organized with a capital stock of $100,000. The company will manufacture electric headlights, electrical apparatus, and other machinery. The incorporators are, J. E. Gaston, J. R. De Mier, D. P. Barker, and R. J. Harmer.

In the double carbon lamp suit of the Brush Electric company of Cleveland, O., against the Western Electric Light Power company of Toledo, O., the defendants have been engaged the last two weeks in taking testimony at the office of the counsel for defendants, George P. Barton, in Chicago. It is probable the examination of witnesses will continue for some weeks to come.

While Janitor Chris Rosser, of the Reynolds Arcade building was on the roof to-day, closing the traps and windows to prevent damage from the rain, he slipped, and in endeavoring to save himself from falling grasped an electric light wire, says a Rochester, N. Y., dispatch dated June 28th. His cries for help brought assistance and he was dragged away. He was badly shocked and only escaped death by the fact that he was at the time standing on a glass skylight.

"In this country the efficiency of dynamos is always a very grave consideration when one is about to make a purchase;" says the London *Electrical Review*, "and, although the term is used more frequently than otherwise in a wrong sense, it forms a most, if not the most, important factor when striking a bargain; and if A can show clearly that his machine will deliver 91½ per cent. of the total output into the external circuit, B with only 91 per cent. stands no chance. It may happen, however, and such cases are not rare, that A's brilliant dynamo is frequently in need of either electrical or mechanical repairs, whereas that of B goes plodding along for year after year with but little attention, so solidly is it built. The question is now: Which is the more efficient machine from the user's point of view—the one which demands a few lumps of coal more per day to produce a given result or that which costs £10 or £15 in twelve months for repairs? The answer is obvious.

The Allgemeine Elektricitats-Gesellschaft of Berlin shows at the Jubilee exhibition a very compact switch board for central station work," says a Vienna correspondent. "The board is designed for seven feeder circuits, but only six of these are used in the electric light station at the Prater, which comprises 1,000 glow lamps and 100 12-ampere arc lamps. The current is supplied by six dynamo machines to the switch board, from which radiate the mains to the rotunda, various transepts and pavilions, and to the two main avenues in the Prater, which are lighted by arc lamps. The board is supported on a stand which contains the resistances required for the regulation of the exciting current of the dynamos, and also the rheostats for the different feeders. The pressure on each feeder can be read off on a voltmeter provided with a multiple switch, and an earth on any circuit is automatically indicated in the usual way, with a lamp and bell. The switch board is chiefly remarkable for the close arrangement of the various switches, and for the small space occupied by the resistances, the whole apparatus being self-contained."

Siemens & Halske of Vienna, have constructed an electric light car containing boiler, steam dynamo and accessories which weighs without coal or water 3 tons, 8 cwt. Steam is supplied by a vertical boiler of ninety square feet heating surface. The dynamo is direct, driven by an inverted engine developing nine horse power. It has a Gramme armature with internal poles. The output is ninety ampères at fifty-five volts pressure, and the makers claim that they obtain one electrical horse power with an expenditure of forty-four pounds of feed water per hour.

The work upon the buildings for the Paris exhibition of 1889 is being actively pushed, and the erection of the iron work is going rapidly forward. The machinery building, which is 1,300 feet long, 450 feet wide and 150 feet high, is the most important of the new buildings, and in connection with the great 300-meter tower, it will form the principal feature of the exhibition. The other buildings include the Fine Arts Palace and the Palace of the Liberal Arts; while the Palace of the Trocadero, which has been standing since 1878, will also be utilized for exhibition purposes. A portion of the buildings and grounds will be open at night and in order to provide for its illumination a syndicate has been formed which is to have a monopoly of the electric lighting and is to receive fifty per cent. of the night admission fees. About three thousand electrical horse power will be required, and this has been divided up into three hundred shares of ten-horse power each, the shares being sold at one thousand francs per share to manufacturers joining the association. The portion which is to be open at night will include the restaurants, and hence it is very probable that the night attendance will be large.

At a recent meeting of the Societé Francaise de Physique, M. Mascart described some interesting experiments which he had carried out with a view of determining how far incandescent lamps might be a source of danger when in the immediate vicinity of inflammable materials. Some 32 candle power incandescent lamps were tightly enveloped in cloth, others in wadding, with the gummed surface removed, and others again, were placed in the folds of some old stage scenery; in no case was there any charring or undue heating. An extra thick cotton hood placed over a 32 candle power lamp became charred whenever it was in contact with the globe after ten minutes had elapsed. A 32 candle power lamp, which was surrounded by a black silk hood and then by a black velvet one, set the latter burning gradually in six minutes. In another experiment two lamps were enveloped respectively in black and white wadding, from which the gummed surface had not been removed, and in two minutes charring commenced, both lamps burst, and the wrappings were set alight. Finally a 300 candle power lamp was laid against some old scenery; in a minute and a half the scenery began to char where the globe touched it, and slowly burnt without flame.

"Atlanta has many enterprises of which she should be proud, and among them may be specially mentioned the Georgia Electric Light company," says a local paper. "This company has been in active operation but a short while, yet it has done such a satisfactory business it is now deemed proper to build an elegant station of its own, and will no longer dwell in rented property. This institution has been of great service to the people of Atlanta, and the good it really will do has just begun. When it is permanently established in its own large brick station, it will do everything it possibly can to render the people of Atlanta efficient service. Its president, Colonel H. E. W. Palmer, is one of the business men in the city and will carefully look after the interests of the company. G. H. Wade is the efficient superintendent and throroughly understands his business. The company are wide awake and buy the very best apparatus to be found. The Thomson-Houston electric apparatus has been introduced by them, and this one fact alone has made the company one of the best and doubled its business just in a few months. Since this noted system has been introduced the company have let out the contract for their new brick station on the State road, and have been awarded the contract for lighting the city for three years. These facts speak volumes for the Georgia Electric Light company, and the Thomson-Houston system of electric lighting."

The illumination at the Cincinnati Centennial exposition was one of the principal features of the exhibition. The gas jets along the streets surrounding the exposition buildings were lighted for the first time on the evening of July 4th. At 8 o'clock the gas was turned on and the tens of thousands of burners started by electricity. The announcement that this would be done attracted thousands of people to the vicinity, and when the illumination suddenly appeared a shout went up which was carried along the line, and continued for some minutes. The jets are located six inches apart, forming myriads of arches, and running on both sides of the street on Twelfth from Race to Canal; on Race from Twelfth to Thirteenth, and on Elm from Twelfth to Thirteenth. Glass globes of various colors, the red, white and blue prevailing, surround the burners, producing a magnificent sight. At the corners of Race and Twelfth and Elm and Twelfth are double arches crossing the streets, and arranged with hundreds of different colors of glass globes. Alternating every few feet are electric light burners, which add greatly to the effect. The light produced makes the entire vicinity as light as day. Nothing of the kind has ever been witnessed in Cincinnati before, and nothing on so grand and magnificent a scale in the west. The illumination seems to serve as a cordial invitation to the spectator to go into the immense array of buildings which it surrounds. The lights will be turned on full every night during the centennial, and are worth traveling a long distance to witness.

THE ELECTRIC MOTOR.

It is reported that the Tampa, Fla., Street Railway company will adopt electricity as a motive power.

The Electric Street Railway building, at Montgomery, Ala., with the machinery and six cars was burned last Saturday. The loss is about $30,000; fully insured.

John H. Barnard of the Sprague Electric Railway Motor company of New York, has been prospecting at Winston, N. C., with a view to building an electrical street railroad.

The Schwartzkopf company, of Berlin, has just constructed a new electric tramway. The current is furnished by a battery of sixty cells, with a capacity of 320 ampère-hours. The motor is a disk dynamo, with double winding on the armature, and two commutators.

The Sprague Electric Railway and Motor company have just closed a contract for People's Railway, Scranton, Pa. The number of cars to be equipped will be twenty, full size new 16 feet, Broadway style; total trackage, 12 miles. This is the principal railway in Scranton, and covers almost the entire city. The steam plant is to be of the most approved construction, and as complete in all its details as that at Richmond.

The Walla Walla, W. T., Light, Power Fuel company, has been incorporated with a capital stock of $150,000. The incorporators are F. D. Boyer, C. B. Hopkins, J. L. Sharpstein, A. I. Jones, N. O. Woods, Wm. A. Egbert and G. W. Babcock. The objects for which the corporation is formed are the acquiring and operation of water power, generating electricity for motive and general purposes, erecting and operating electrical works and plants, dealing in electrical goods and appliances, constructing and operating street railways in Washington Territory, Oregon and Idaho.

"Americans are becoming thoroughly imbued with the belief that the horse is now out of date as a car motor," says the London *Electrical Review*. "They are ever ready to be off with the old love and on with the new if there is a prospect, as here, of the new serving them better than the old. Romantic people may suggest that we in Old England are gifted with a greater degree of constancy. Well, constancy is in itself and in its proper place a very noble and admirable quality; but this is not a matter of romance, but one of stern, matter of fact business, and all who are concerned for England's industrial progress will desire to witness a very general renunciation of old loves in the coming time."

"The day is not far distant when all central street car lines in St. Louis must have rapid transit," says John Scullin, president of the St. Louis Jefferson Ave. Railway company and the Mound City Railway company. "To date the cable has been adopted as the most available means of locomotion, but I am not sufficiently satisfied on the point of its superiority, cost being considered, to adopt the cable for the lines I control. I fully recognize that before another year rolls around we must have rapid transit, but a thorough test will first be given electricity, which costs far less, and I firmly believe will eventually be brought under such control as to provide the best as well as the most economical motor. In addition, the electric motor is not as dangerous in crowded streets as the grip car, and if it can be demonstrated as a practicable means of locomotion, I would favor its adoption on this score alone."

In commenting on the paper of Nikola Tesla, on a new system of alternating current motors, the London *Electrical Engineer* says: "Mr. Tesla's work, be it crude and impracticable, or fairly perfect and practical, will enforce the dictum that a want has only to be felt, and sooner or later it will be supplied. We have never sided with those who professed such apparatus to be impossible. The great number of mechanical and continuously rotary movements are obtained by the application of opposite forces at different periods. The maid servant draws a pail of water from the bottom of a well by alternately pushing and pulling on the handle of the windlass. The locomotive goes continuously forward, by reason of the expansive force of steam applied first in one direction then in the opposite direction, and it was doing an injustice to the inventive talent of the world to believe that the push and pull of electricity could not be used to obtain continuous motion in any desired direction. The views expressed by Mr. Tesla in his paper will be carefully studied, and, without doubt, there will follow many improvements in the direction he has pointed out."

THE TELEPHONE.

The Sunset Telephone company has put up a wire between Sacramento and Woodland, Cal.

One of the wires of the Electric Light company in East Oakland, Cal., recently fell on some telephone wires and burned out a part of the central office machinery, and two telephones. The damage was about $100.

Chicago was visited by an unusually severe thunderstorm last Sunday morning. The telephone and telegraph operators had a lively time with the sparks that buzzed about their instruments. The storm did little if any damage.

The Southern New England Telephone company is to put up a large building on Court street in New Haven. It will contain, besides the Central and Telephone exchange, the executive offices of the company and a public telephone station.

Manager Riggs, of the Meriden, Conn., telephone office, has been investigating the workings of the electric road at Birmingham, to see if some means cannot be devised whereby the current will not affect the telephone wires. At present the telephone service there is rendered practically useless by the influence of the current from the rails of the road, which are used in the Van Depoele system. Mr. Riggs say that while a complete metallic current is made by using the rail for the return current, yet enough escapes to work havoc among telephone wires. It was believed heretofore that even if one wire of a circuit was laid on the

ground, that a perfect circuit would be established, but Birmingham troubles prove the contrary, as enough of the current escapes into the ground to affect wires a thousand feet away. The Southern New England Telephone company will begin experimenting at once toward removing the trouble.

At Montreal, Can., recently, the case of Howe vs. the Federal Telephone company and the city closed, when judgment was rendered by Justice Taschereau quashing the writ of injunction, with costs, on the contestation by the city. A few weeks ago the same writ was also quashed on the contestation by the Federal company. The judgment, therefore, ends the dispute between the rival telephone companies.

All the life saving stations on the Atlantic coast of Long Island are to be connected with each other by telephone, and those isolated from the mainland are to be connected by telephone or telegraph with the nearest villages. Surveyor Boland of the treasury department, Washington, is at present engaged making a survey for the laying of a cable between Montauk Point and Rockaway beach. It is expected that the work will be completed by October 1st.

At Washington the National House of Representatives has made an appropriation of $36,000 for putting the District telegraph and telephone wires underground. On the 13th inst. the senate concurred with an amendment striking out the clause which required all telephone and telegraph and other wires to be removed from the streets, whereupon the District wires shall have been removed. The bill now goes back to the house to see whether that body will agree to the striking out of this provision.

At Montreal, Canada, on May 18, the city clerk received a letter from the Dominion Subway company withdrawing its request to be permitted to lay subways along the streets for the various companies to place their wires in. The reason stated is that it has received a communication from the Bell Telephone company cancelling the contract of December 30, 1887, between the Bell Telephone company and the Dominion Subway company, because the city of Montreal has granted to another telephone company permission to carry its wires above ground. The letter concludes by stating that should the corporation desire to order all wires under ground it will renew its petition, and when it is granted will proceed with the work. Acting Mayor Cunningham signed the contract entered into between the city and the Federal Telephone company, which gives the company the right of erecting poles upon the street.

THE TELEGRAPH.

It is estimated that the Associated Press sent over the wires from Chicago nearly 300,000 words during convention week.

Fred L. Wellner, formerly a well known telegraph operator in Chicago, shot himself at Pittsburgh last Sunday. He introduced the use of the type writer in connection with receiving messages.

Henry S. Ives, the "young Napoleon of finance," has learned telegraphy and has become an expert operator, it is said. It is Mr. Ives' boast that if he ever gets hard up and can find no other employment he will make a living as telegraph operator.

The Chino Valley, Cal., Railroad company has been incorporated to construct a railroad and telegraph line running from the town of Ontario in the county of San Bernardino to some point on the Pacific Ocean in Los Angeles county. The estimated length of the railroad and telegraph line is forty miles. The place of business of the company is to be at Chino, and the term for which the company is chartered is fifty years.

The supervision which is maintained by the German government over the reports sent from telegraph offices is indicated by the following preface to a telegraph: "A part of the following dispatch was written in Berlin, but the authorities in the telegraph office had received such stringent instructions immediately after the expulsion of the two French journalists that they were shy of sending anything dealing directly with members of the royal family."

The Western Union Telegraph company is erecting a copper wire between San Francisco and Los Angeles, by way of San Luis Obispo, Santa Barbara, and San Buenaventura. A third cable is being laid across the bay, and throughout the company's system in California new lines are being constructed, and old ones repaired. The system has doubled within five years, and is expected to more than double in the next five years. An additional wire is to be erected between San Francisco and Portland.

A movement for the extension of the telegraph system in the Outer Hebrides in order to facilitate the increasing work in the telegraphic department of the post office is, it is understood, likely soon to be brought under the notice of the English authorities. To accomplish this it is proposed that Lochmaddy, in Uist, and Dunvegan, in Skye, should be connected by a cable, the distance across the Minch between these two places being rather less than twenty-four miles, thus making a direct communication between the southern portion of the Long Island and the mainland.

"We have instructions to send messages exactly as written," said a telegraph operator. "If there are any misspelled words the receiving clerk is requested by the company to politely call the attention of the customer to them. I tried that a few times, and the result convinced me that the average man cannot appreciate the superior knowledge of the telegraph operator. From my observation, there is no English word that is so often misspelled, or has so great a variety of original forms, as 'immediately,' although 'answer' does not come far behind. 'Ancer amedatly' is one combination that I remember."

Since the riots which have taken place in Trafalgar Square, London, the attention of the authorities has been directed to the perfecting and extension of the police telegraph system throughout the metropolis. The scheme has been carried out on an extensive scale. The central police offices are connected either by telegraph or telephone with the fire brigade stations, the war office, the home office, the house of commons, and the house of lords, as well as with the private residences of the superior officers. In addition to these extensions, in case of emergency a message handed in at any postal telegraph office by a police officer is to take precedence of any others.

Personal Paragraphs.

W. W. Leggett, president of the Detroit Brush company, was in Chicago last week.

J. M. Jackson, secretary and treasurer of the Western Electric company of Chicago, returned last week from an extended trip in the east, devoted in a small part to the pleasure of a vacation and in a large part to business.

Captain J. P. Keiser of the Laclede Gas company of St. Louis, will leave on the 14th for an extended tour through Europe. The matter of the proposed purchase of an arc light plant has been postponed until after his return, September 20th.

Alderman Thomas C. Clarke, for many years an influential member of the Chicago common council died suddenly, July 6th. He took an active part in pushing municipal legislation of a progressive and reformatory character. As chairman of the committee on fire and water of the old council he was mainly instrumental in securing for the city such electric light plant as it now possesses. It was he, in connection with Prof. Barrett, that conceived the plan of lighting the city hall and the tunnels with electricity. Last year he carried out the scheme to light the bridges and the river in the same way. He made a gallant fight for a large appropriation for the extension of the electric light system this year, and it was mainly due to his exertions that $60,000 was set apart as the nucleus of a fund for electric light plant in the business portion of the south division. He was untiring in his efforts to promote the success of this scheme. The results, as far as they have gone, justified his forethought and recommendations. He was also the author of the bridge telephone system and of the plan of river police and ununiformed harbormasters and bridge tenders.

Years ago, when Thomas A. Edison was a telegraph operator in the office of the old Franklin company on Wall street, he was continually getting himself into trouble by perpetrating electrical pranks on his brother operators, says the New York *Telegram*. The instruments in those days were placed on shelf-like desks ranged along the walls of the operating-room, and Edison's place was in a corner of the room. Here he concocted all his schemes for making life miserable to every one and everything about him. In the cloak room was a large tank, generally filled with ice water, beside which hung a tin dipper on a nail in the wall. Edison connected this nail with a wire, at the other end of which were 190 cells of Fuller battery, strong enough to make one think he had been struck by the paddlew heel of a Fall River steamer. The future "Wizard of Menlo" then placed a sign below the dipper requesting all to "Please return this dipper." His request was heeded. The dipper was never taken down, but there were a dozen or more wrenched arms in the office in less than an hour. All this time the youthful inventor was working on the quadruplex telegraph scheme, which he afterward perfected, and which is now the principal system in use by the Western Union company.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	350	375
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	150	155
Iowa Union	27	28
Missouri and Kansas	70	71

Miscellaneous Notes.

The message of the phonograph is called the phonogram.

The Western Electric company of Chicago has sold a 300 number annunciator to the St. Charles hotel of New Orleans, and a 280 number annunciator to the Grand Avenue hotel at Kansas City.

The office and laboratory of the Cowles electric aluminum works in Lockport, N. Y., in a building detached from the smelting works, were burned recently. The building burned with such rapidity that nothing was saved.

The Institute of Medical Electricity of London is investigating the phenomena of thunderstorms and lightning accidents. The electrician of the organization, H. Newman Lawrence, 24 Regent street, London, S. W., asks that electrical and physiological details as well as reliable general information be sent him.

G. Kamienski, a German engineer, says in speaking of electric welding: The high temperature of electric arc is not only very harmful to the eyes, but, it is stated, affects the skin of the face, peeling off the surface skin, and sometimes even causing wounds. The dark glasses hitherto used are too heavy and too dark, and occasionally it is necessary, in order to see clearly the progress of the work, to take them off, with great danger to the eyes. The silk masks which have been tried are unpractical, and also obstruct the breathing. The great luminosity of the arc besides, though not noticeably hot at a short distance, evidently affects the nerves in the manner of sunstroke. A curious feeling is noticed by bystanders at the nape of the neck, which renders them giddy and uncomfortable; and persons who have already suffered from an attack of sunstroke are threatened with a renewal of the symptoms under the glare of the arc.

Exhaustive experiments in the manufacture of aluminium have recently been made at the Krupp works at Essen, Germany, and with the most gratifying results. The metal is turned out pure in chunks, some of which weigh nearly 100 pounds, and the cost of production is said to be considerably less than twenty-five cents per pound. A company has been formed in England for conducting the manufacture on a large scale, and its patents also cover the manufacture of sodium, potassium, and artificial cryolite. There can be no doubt that when once aluminium is offered for sale at a few cents per pound it will come into general use.

A dispatch from Pittsburg says: "Many prominent railroad men were present at a private trial of an automatic electric block signal system here last week. The demonstration was pronounced by them a perfect success, and bound to revolutionize all present systems, being especially valuable on account of its simplicity and economy, and doing away with the army of telegraphers. It is especially adapted to single-line railroads, as, on entering a block, danger signals are displayed at each end until another block is entered, when safety signs are shown. This is all accomplished by means of an electric battery in the engine which communicates to the signals by means of a wire brush touching a raised iron rail at each block."

Dr. B. W. Richardson contends that the method of execution by electricity is not certain, and that in exceptional cases the shock will only stun. In experiments conducted by himself, he found that a sheep which was supposed to have been killed by the electric discharge recovered in a few minutes, and had to be dispatched by the ordinary method. In another case, a large dog which was supposed to be dead was operated upon, and made a safe and easy recovery. He therefore urges the authorities of New York, where the electric method is to come into operation in January next, to make certain that death takes place by holding a post mortem examination of condemned criminals, so that they may not be buried alive.

One of the terrors to the country contingent at the convention is the cable cars, and they have proven a constant menace to life and limb, says the St. Louis *Globe-Democrat* in a convention special. Not less than ten strangers in the city have been killed or maimed by the invisible motor conveyances. The Chicago cable car is no snail-like concern, but rushes into a crowd like a runaway horse. People push and jostle each other in their efforts to escape from contact with one grip car and find themselves right in front of another. It seems that on the cable roads the cars are always passing each other, and the clang of the bells is so confusing that pedestrians hardly know which way to turn for safety.

At a recent meeting of the board of trustees of the Town of Lake, was unanimously passed the following resolution: "That all parties before commencing to string telegraph, telephone or electric light wires along, upon or over the streets and alleys of this town, shall first make application to the superintendent of the department of public works, for permission to do the same, and that when such applicants shall have been already authorized by ordinance to erect telegraph, telephone or electric light lines within the limits of the town, the said superintendent shall grant such permits subject to the approval of the town electrician, and the consent of neither shall be withheld, unless the particular time and manner of performing the work desired to be done seriously conflicts with the public safety and convenience. All resolutions and parts of resolutions in conflict herewith be, and the same are hereby rescinded."

The London *Lancet* objects to the taking-off of criminals by electricity, as not having sufficient of the terrible associated with it. "If the execution of criminals is to be maintained it must carry with it some degree of terror. If it does not, then, even in the eyes of those who are in favor of it, it will be looked upon as a solemn and cruel farce. If the transit from life to death is to be made more easy than the common modes of disease, then an actual premium will be put upon crime." The *Lancet* forgets that hanging, the guillotine, etc., are all easier than the common modes of disease. If the object is to make death terrible, we must go back to the mediæval methods, and draw and quarter our victims, or roast over a slow fire. The real object is to make death terrible without brutality, and that is accomplished by causing the condemned to drop out of sight forever from the moment of condemnation.—*Globe-Democrat.*

Senator Sherman is of an ingenious turn of mind and takes a great interest in all new inventions, says a Washington dispatch. Learning to-day that a graphophone had been placed in one of the committee rooms of the senate he expressed a desire to see it. A fellow senator who had seen the machine in operation and had heard it recite, "Romans, Countrymen, and Lovers," and whistle "What do the Dicky Birds Say?" kindly volunteered to exhibit the invention. Senator Sherman looked it over with great interest and manifest pleasure while the little waxen scroll was being put in place. Then the rubber ear piece was adjusted to the senator's head and the graphophone set in operation by gentle pressure upon the pedal. Every one present watched the senator's face closely, expecting to see a broad smile of appreciation. Nobody knew what had been inscribed upon the scroll. The senator listened a moment, a scowl gathered upon his face, and, taking off the ear-piece, he left the room unceremoniously, saying as he departed: "Good enough machine, I suppose, but I don't see any practical use for it." A curious senator who had been present, surmising that Senator Sherman's faint praise might in some way be traceable to the message ground out by the machine, put the ear-piece to his own ear and repeated the legend. Amid much screeching it came plainly enough: "Hurrah, hurrah, hurrah for Ben Harrison; he is a daisy."

Business Mention.

The enterprising firm of Benson & Thomson, the insulated wire manufacturers of Philadelphia, have just gotten out a new sample card, which they will be pleased to mail free on application.

William A. Doty, of 727 Filbert street, Philadelphia, is a young and enterprising electrical merchant and manufacturer, who finds his business steadily expanding. He furnishes good apparatus at reasonable prices.

W. J. Buckley of the Fort Wayne Jenney Electric Light company has secured a contract with the city of St. Louis for a twenty arc light plant, and a 150 incandescent light plant for the water works buildings and tower.

Chas. A. Schieren & Co., of New York, report recent sales of leather link belting for use on dynamos to the following: Keystone Electric Light company, Philadelphia, Pa.; Hudson Electric Light company, Hudson, N. Y.; Mountain City Light, Heat & Power company, Altoona, Pa.; Baldwin Locomotive works, Philadelphia, Pa.

Holmes, Booth & Haydens have had G. B. Prescott, Jr., prepare a table of incandescent lamp leads, showing sizes of wire required to carry from 1 to 1,000 amperes from 10 to 10,000 feet at one volt fall of potential. The table has been carefully calculated and is well adapted to the wants of those who have to figure on circuits. The table will be mailed to any address upon receipt of 25 cents.

It is reported on good authority that of all the men in the electrical business, those making the most money, are the Sprague agents. Their energy and push are remarkable, and with the Sprague system they feel that they are invincible. It is understood that there is to be a convention of these representatives in New York in the near future, when they will celebrate their business success.

The Railway Telegraph Supply company, M. A. Knapp, manager, 54 Franklin street, Chicago, reports a very satisfactory business, especially in annunciators, the mail orders for a single day recently aggregating seventy annunciators, the largest a 125-number. In magneto bells the trade is constantly increasing, while the new magneto test, shown in a recent number of the WESTERN ELECTRICIAN, meets great favor, one man ordering eight of them at one time.

The superintendent of fire alarm telegraph of Cleveland, O., in his annual report for the year ending Dec. 31, 1887, after referring to the number of new poles set and old ones removed, and quantity of new wire strung and old wire taken down, says "7,384 feet of okonite insulated wire was placed, and works well." Further on in the report, referring to underground wires, he says: "The okonite insulated wire is working much better than any aerial line now in use in this department." The manufacturers of okonite wire for aerial and underground purposes, report business very good.

F. B. Thurber, of Thurber, Wyland & Co. of New York, is soundly convinced of the superiority of the electric motor, as this letter, addressed to Zimer, Boiles & Dunkak evinces:

"*Gentlemen:*—G. W. La Rue informs me that he has had some conversation with you about putting in an electric motor, but that you have an idea of putting in a steam engine. If our experience is worth anything to you, I do not think you will want to put in a steam engine. We have just had to take one out of our printing office, because we found it more expensive and less satisfactory than the Sprague electric motor. It is simpler, more efficient, no repairs, as there is all the time on a steam engine; does not heat up the building, requires no engineer with a certificate, and is more economical. It does not affect the insurance, and the underwriters give permits for it. If you will investigate the experience of others who are using the motors, I think you will not consider putting in a steam engine."

William Canby, President of the Wilmington City Railway company, under date of June 14, writes the Sprague Electric Railway and Motor company as follows: "I desire to express to you our entire satisfaction with the overhead system of electric propulsion of street cars as constructed by you on the Riverview extension of our line. The system has been in operation here for three months, and from a practical experience during that time we can pronounce it a complete success. In fact, we consider it by all odds the best and most economical mode of running street cars in suburban districts, or in any place where permission to erect poles can be obtained. In comparison with horse power, we find it decidedly cheaper, and more efficient in every way. It is popular with our patrons on account of its cleanliness, its smooth and rapid motion, and especially for the absence of the usually overtasked and laboring horse. Our road is quite hilly, and the cars, loaded sometimes with seventy passengers, climb with ease, at the rate of five miles an hour, a five and a half per cent. grade having a ninety foot curve. The cars are sixteen feet long, and each has been running continuously from the start sixteen hours a day, making sixty-four miles daily on the one and one-third miles of our extension. At first, many persons here were skeptical about the successful use of electricity as a motive power instead of horses, but the practical demonstration made on our line has converted them, and directors, press and public have only words of praise for electricity, and indorse it as the future motive power for street car traffic."

The Woodward Electrical company, of Detroit, Mich., have just issued a circular letter as follows: "The Woodward Electrical company, of this city, who control the patent covering the Woodward storage battery, thermo-pile, primary battery, and other valuable inventions appertaining to electricity, for the United States, respectfully solicit your thorough investigation of same, and the practical workings thereof, with a view to investment. The storage of electricity has passed through the three stages common to all new enterprises, those of ridicule, discussion and adoption, and is now firmly established as a great and growing industry and a profitable business. It is the purpose of this, the parent company, to grant franchises to sub-companies in the various states, after the methods of the Edison Electric Lighting company and the Bell Telephone company, and to manufacture and supply such companies with the products made under its various patents. Our patents have undergone a rigid examination at the hands of the most eminent legal authority in the country, and while they cover several new inventions heretofore unknown to the electrical world, are declared to be absolutely unassailable. Eminent electricians concede to us greater capacity and efficiency than any other storage system in existence. This company has carefully avoided any public solicitation for the purchase of its stock since its organization, its policy being absolute certainty as to the merits of its various patents before inviting investment therein. With this result achieved, they now offer a limited amount of their stock for sale to acceptable parties. The practical working of this wonderful invention is daily being demonstroted by a remarkably interesting and elaborate display at the company's office in the Campau building, 69 Griswold street, where any information you may desire will be cheerfully afforded you."

The Electrical Supply company, of Chicago, have placed upon the market the electric safeguard for the human body described by P. B. Delany before the American Institute of Electrical Engineers at its annual meeting recently. In brief the safegnard consists of metallic bracelets, worn on the wrists, connected to wires running up the arms over the shoulders, uniting in one wire that follows the line of the spine, befurcating at the small of the back and running down the legs to bracelets just below the knees. A circular from the company gives more information: "This safeguard is a protection from powerful currents. It is not an absolute preventive of shocks, and wearers are therefore cautioned against foolishly exposing themselves and undertaking unusual risk by reason of the safeguard. It will not prevent or lessen injury to the hands, and the effect of high currents will also be felt at the wrists and legs where the bracelets make contact. It will be apparent that a great portion of the current which would otherwise pass through the body will follow the wire which has but the fraction of an ohm resistance, in preference to the body, varying in resistance from five to twenty thousand ohms. The exact proportion of current going from the wire to the body it is almost impossible to determine, so much depends upon conditions constantly varying. If the bracelets fit the limbs closely, and the skin be moist at the points of contact, as a matter of course a greater proportion of the current will be shunted from the body than would be if the bracelets were loose and the skin very dry. It is estimated that an average of 50 per cent. of the current is carried off by the shunt, which, in all ordinary cases, is sufficient to prevent fatal injury. The safeguard is put on the market as a practical and highly beneficial adjunct to the safety of all whose duty exposes them to the dangers of high currents. If electric light companies would furnish the safeguards to their men their liability for damages would be greatly lessened, and the failure of an employe to wear the article would throw him out of court. Recently a company was made to pay $10,000 damages to a man for injuries sustained from an electric light current. The use of the safegnard would have saved this. Electric light companies cannot afford to overlook this matter."

Electrical Patents.

Issued July 3, 1888.

385,344. Porous Cup for Galvanic Batteries. Asahel K. Eaton, Brooklyn, N. Y.

The invention consists in the method of producing a porous cup by first forming the cup of sheet asbestos by pressing the pulp into a mold, then soaking the cup thus formed in a mixture of carbonaceous substance and silicate of soda, and allowing the cup to dry, and finally subjecting it to a high heat.

385,357. Combined Speaking and Signaling Apparatus. John E. Kelly, Camden, N. J.

385,363. Switch Signal. Adelard F. Martel, Montreal, Quebec, Canada.

385,379. Current Collector for Series Electric Railways. Sidney H. Short, Denver, Col.

385,384. Method of Joining Pipes by Electricity. Elihu Thomson, Lynn, Mass.

Claim 1 is given: "The herein-described method of uniting sections of pipe, consisting in applying a sleeve or collar or coupling tube to the adjoining ends of the sections, and then passing a heavy electric current through the parts to effect a union of the sleeve and pipe, thus completing the joint."

385,385. Method of Electrically Welding Chains and Links. Elihu Thomson, Lynn, Mass.

The first claim follows: "The herein-described process of manufacturing links, rings, and other endless shapes of metal, consisting in forming two U or horseshoe shaped portions, placing the open or free ends of the same together, and then passing a welding soldering, or brazing current of electricity across the joint between the two halves or portions."

385,586. Direct Electric Welding Machine. Elihu Thomson, Lynn, Mass.

385,388. Electric Signal Transmitter. William C. Thompson, Minneapolis, Minn.

The invention is designed for use in connection with the American District Telegraph system, and it has for its object to improve the means of answering back signals turned in from call boxes.

385,390. Secondary or Storage Electric Battery. Sylvannis L. Trippe, Denver, Col.

385,413. Electric Railway, Power, and Lighting Appliance. Isaac W. Heysinger, Philadelphia, Pa.

The last claim is given: "19. In combination with one or more fuel gas engines and a fuel gas supply main conveying said gas from a distant source of supply to said engines, a trough surrounding said gas main and containing one or more electric wires extended along the same, together with a mass of insulating material in said trough extended along said main, supporting and insulating said electric wires."

385,436. Electric Lamp Socket. John S. Adams and Albert W. Morrell, Indianapolis, Ind.

385,458. Dynamo Electric Machine. August Harding, Oakland, Cal.

385,482. Test Signal Circuit, Charles E. Scribner, Chicago, Ill.

The invention is especially designed for use in connection with telephone lines which are connected each with a switch on each of the boards in two branches, one branch extending through the contacts of the switches and an annunciator to ground, and the other branch being connected permanently to the insulated frames or test pieces of the different switches in the line.

The first claim is given: "1. The combination, with a normally open ground circuit including a bell or signal device of low resistance, of a telephone line provided with two branches, one branch connected through the switches of the line on two or more switch boards and through a polarized annunciator to ground, the other branch being connected to the insulated frames or test pieces of said switches, the armature of said polarized annunciator, and a ground contact point, whereby on closing said ground circuit to the frame or test piece of one of the switches the coils of the polarized annunciator will be shunted out of circuit, and the signal instrument operated."

385,493. Suspension Arm for Electric Lamps. James J. Wood, Brooklyn, N. Y.

385,494. Cut Out. Charles D. Wright, Petersburg, Ill.

385,528. Spring Jack Switch. Charles E. Scribner, Chicago, Ill.

The second claim is given: "2. L, a spring jack switch, a spring or lever with its free end provided with a concave and bent or crimped surface conforming to the shape of the plug point inserted therein."

385,539. Electric Switch. Edward F. Bergman, Frankfort, N. Y.

385,556. Medicated Electric Belt. Cyrus U. Hoke, Reading, Pa.

385,558. Secondary Battery. Frank King, Fulham, county of Middlesex, England.

The object of the improvement is to prevent buckling of the positive pole plates when such plates are subjected to over-discharge and to provide for removing said plates when desired

The last claim is given: "11 In the secondary battery the combination of a plate or element and one or more separators therefor, each consisting of a separate and independent pair of strips of insulating material united at one end, and one or more notches or seats formed in said plates to receive said separators and prevent displacement thereof."

385,565. Electro Mechanical Type Writer. James F. McLaughlin, Philadelphia, Pa.

Claims 8 and 12 follow:

"The combination of the series of pivoted type levers provided with balls or weights on their free ends, the balls or weights having a perpendicular aperture therethrough, and the adjustable interchangeable letter type.

"As a new article of manufacture, a type lever provided with weight balls provided with insertible adjustable letter type."

385,576 Insulated Conductor. Clarence C. Sibley, New York, N Y

The invention consists in a conductor having a covering of rubber or analagous substance and an additional covering of asbestos fibers The asbestos fibers form a non-combustible insulation, while the rubber covering prevents moisture passing to the conductor.

385,647 Electric Meter. Elihu Thomson, Lynn, Mass.

The claim is given: "The combination, with an electric meter, of a current controller governing the flow of current to the same and a controller magnet or other electro-responsive device adjusted, as described, to permit an increase in the flow of current to the meter when the current to be measured falls below that to which the meter responds normally."

385,649. Device for Imparting End Motion to Shafts. Stonewall Tompkins, Crozet, Va.

385,664. Telephone Transmitter. Julius Emmner, Jr., Washington, D. C.

The first claim is given: "The combination, with a suitable diaphragm electrode of a series of movable or balanced electrodes mounted on the diaphragm, but insulated therefrom and swung on a rod having devices for adjusting the balanced electrodes laterally."

385,672. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa

The object of the invention is to provide a method of braking the electric motor and consists in increasing the counter electromotive force of the motor until it increases above the initial electromotive force, whereby the motor is converted into a generator or dynamo electric machine and is driven by the momentum of the car and then establishing a closed circuit from the source of electric supply for the motor, energizing a friction brake to quickly stop the train, as the speed of the motor slows down, the strength of the field magnets may be increased to maintain the counter electromotive force above the initial electromotive force of the source of supply.

385,675. Electro Motor and Dynamo Machine. Orazio Lugo, New York, N. Y.

385,677. Railway Signal Adelard F. Martel, Montreal, Quebec, Canada.

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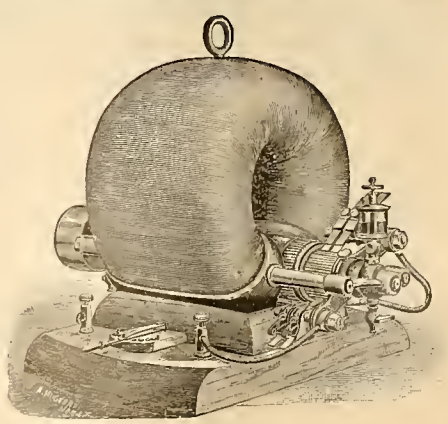

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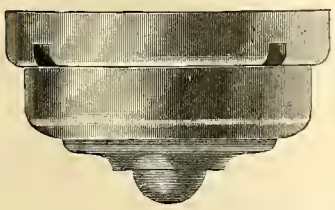
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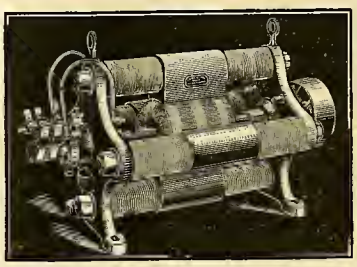
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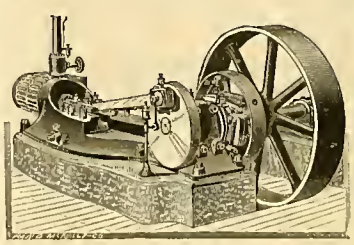

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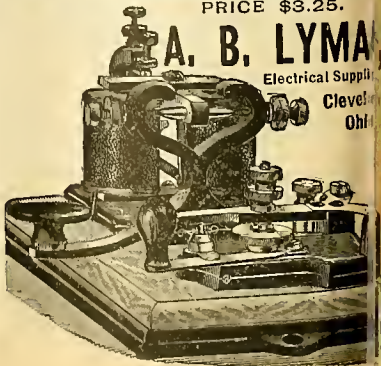

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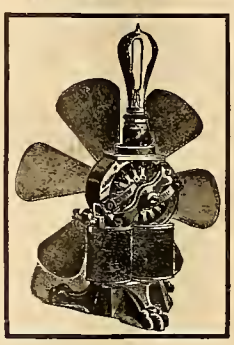

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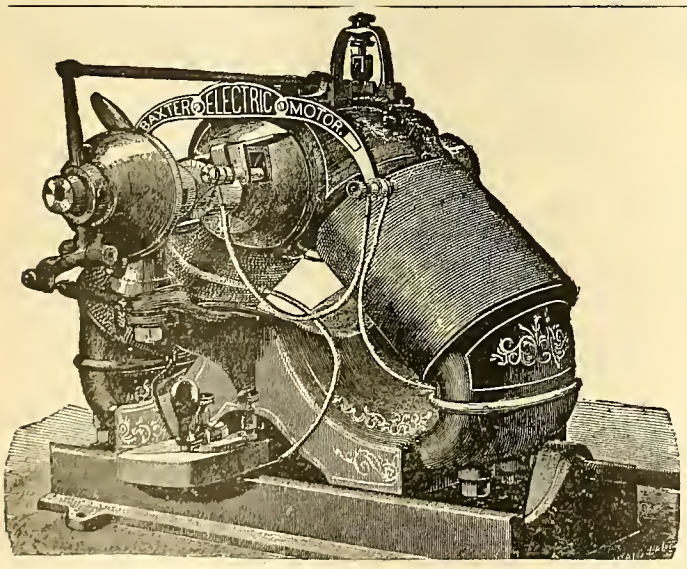

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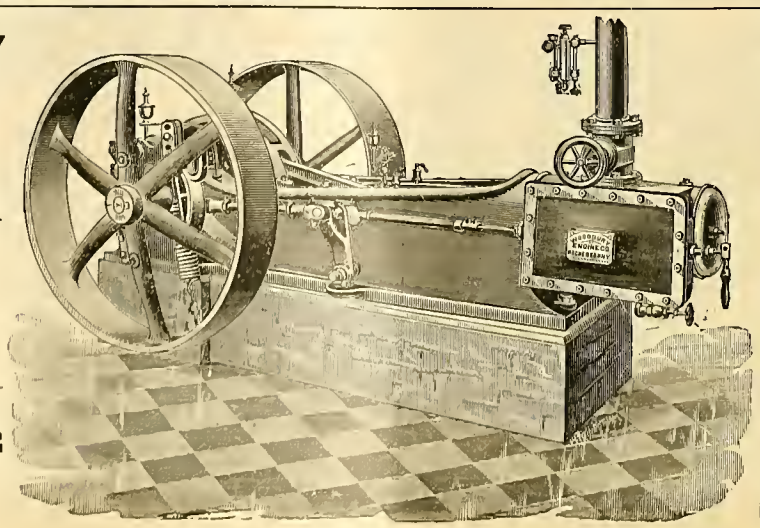

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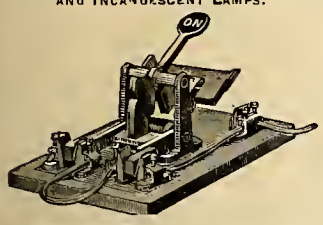

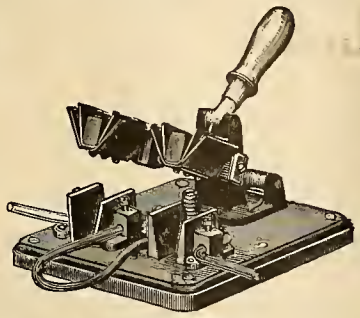

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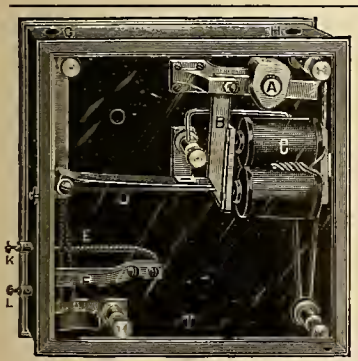

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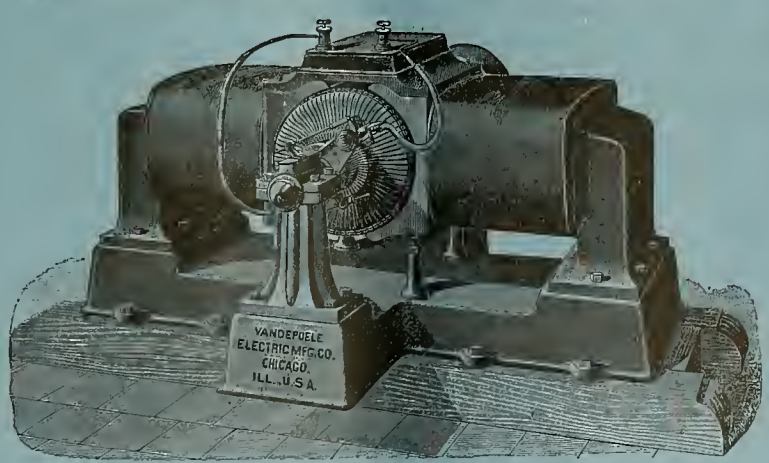

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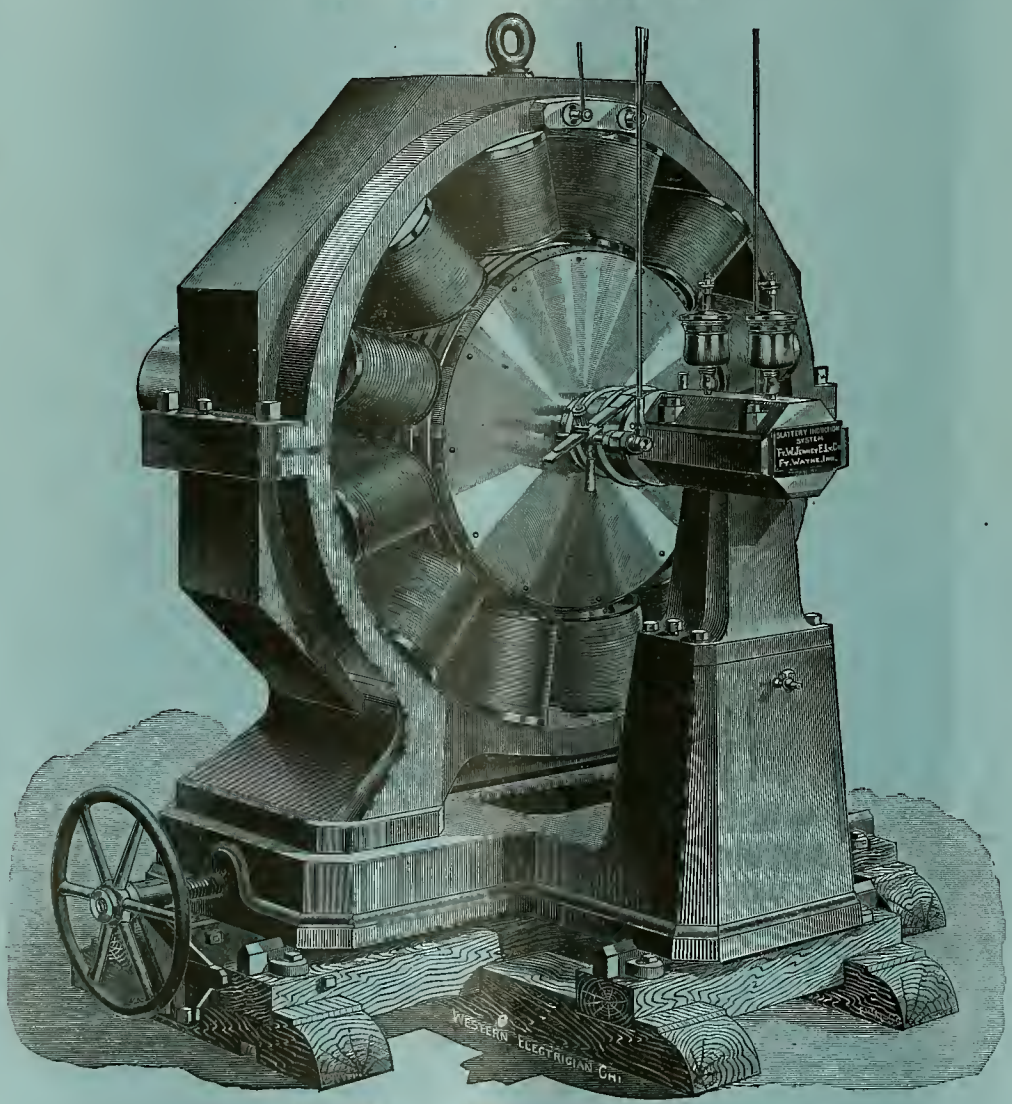

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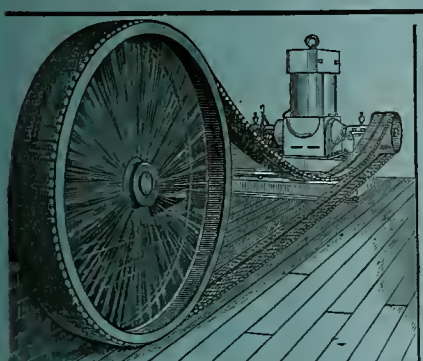

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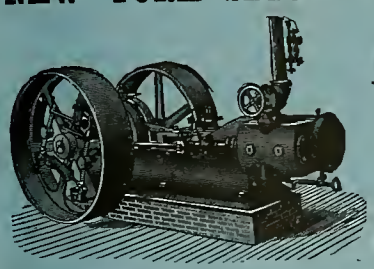
NEW YORK SAFETY STEAM POWER CO.,

Builders of High Grade Self-Contained



Automatic Cut-Off Engines,

ESPECIALLY ADAPTED FOR RUNNING

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And other duty requiring close regulation of speed.

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A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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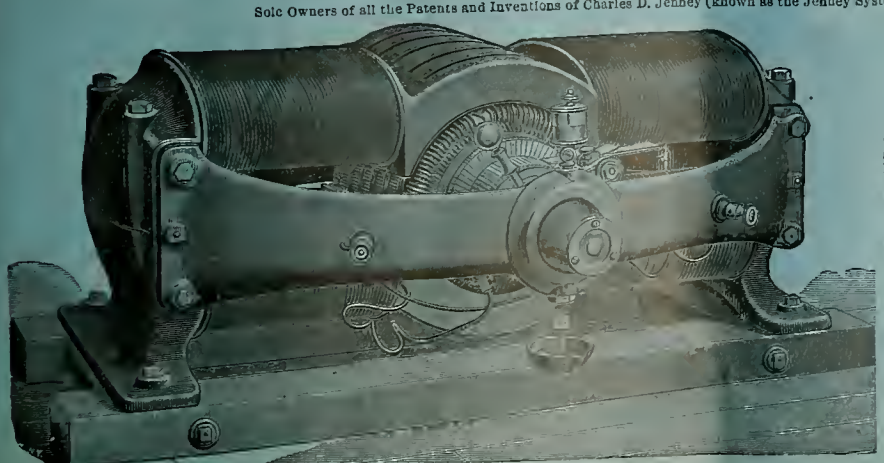
INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

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ONLY PERFECT AUTOMATIC SYSTEM

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Electric Arc-Lighting

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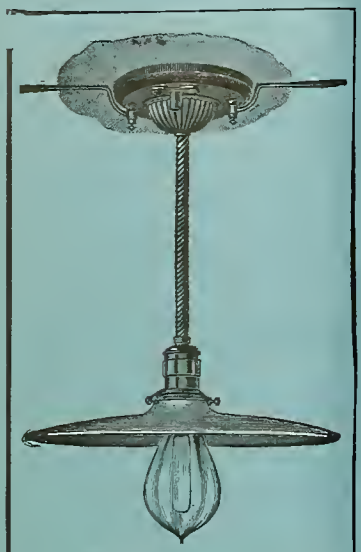

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These Lamps have repeatedly shown their superiority under test.

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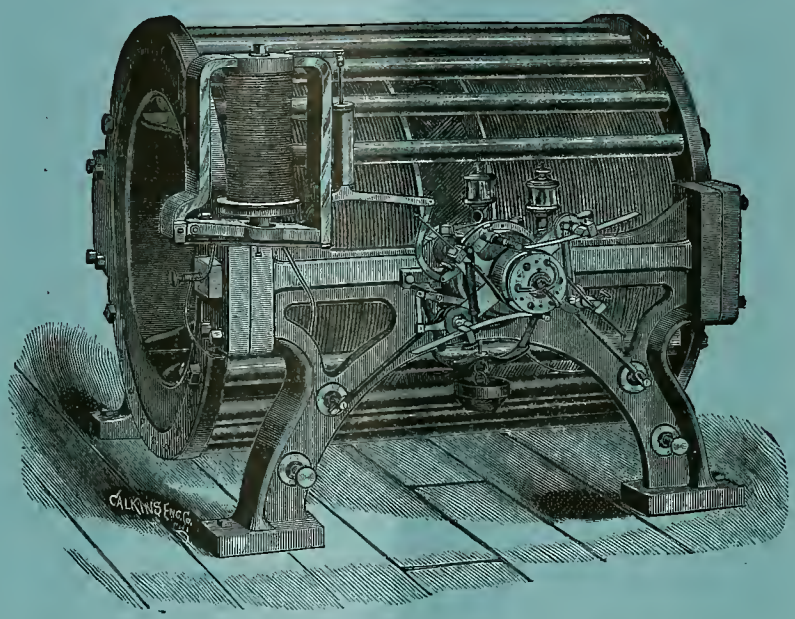

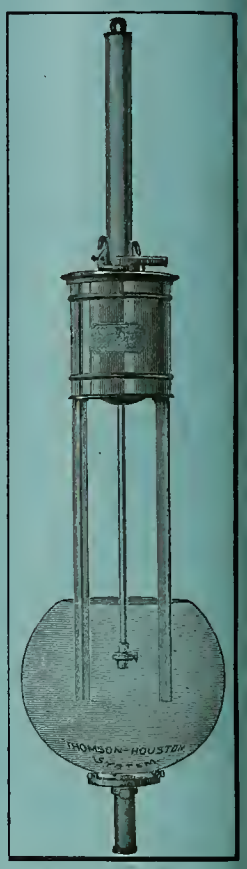

This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

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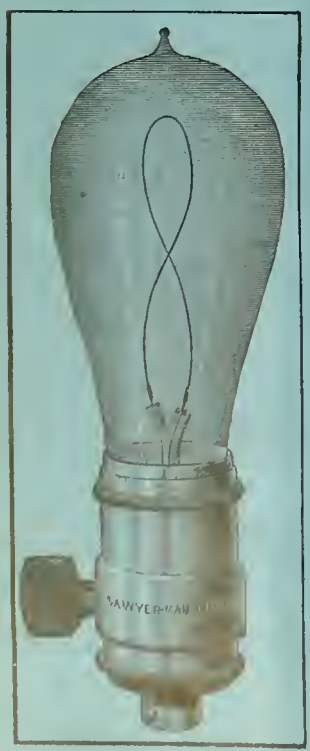
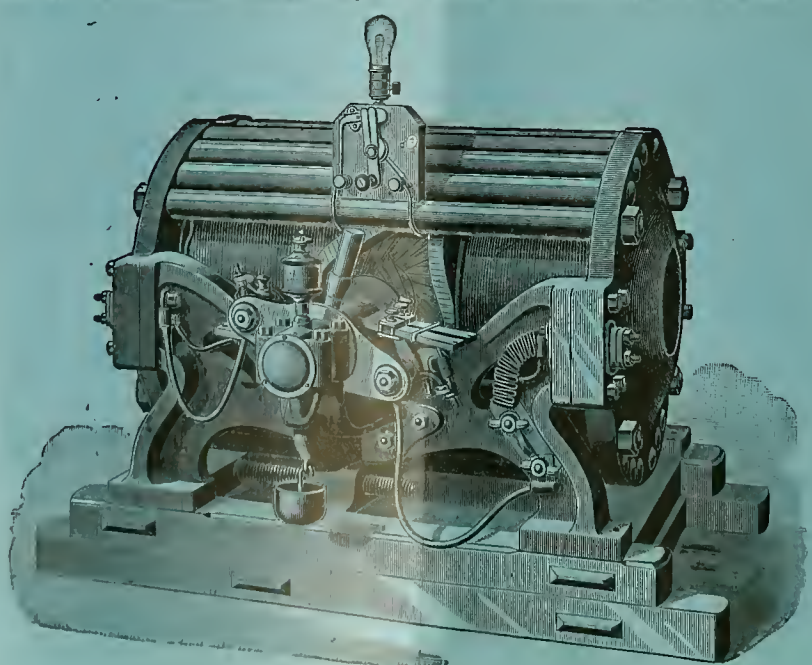
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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ELECTRIC LIGHT SUPPLIES

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Owing to the Automatic and Self-Regulating features of the DYNAMO MACHINE (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

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Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

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CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

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GRAND OPERA HOUSE

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610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

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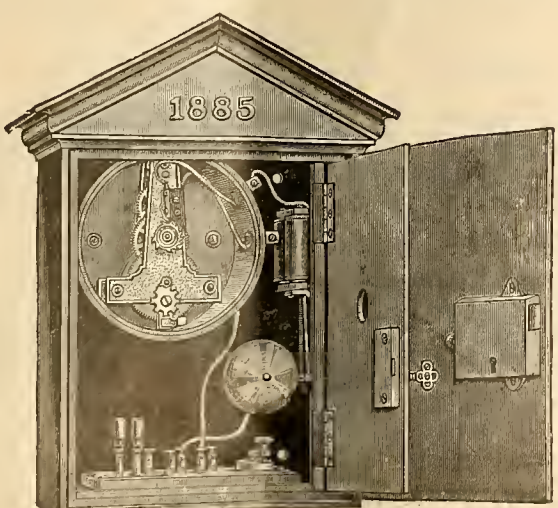

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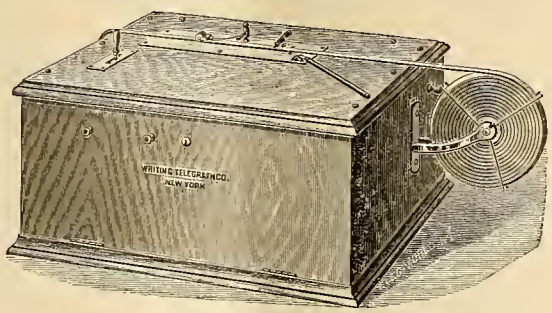

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The Battery holds up longer when overworked, recovers quicker when relieved, and the material being all in one piece instead of in two pieces, the breakage heretofore suffered in transportation, in handling, and in any depolarizing treatment (after accidental short circuiting) will be wholly saved. *"It was good before; it is better now."* The Battery *otherwise* is unchanged. The negative element is of the same material and undergoes the same preparation as before, and is *everlasting*, and so guaranteed.

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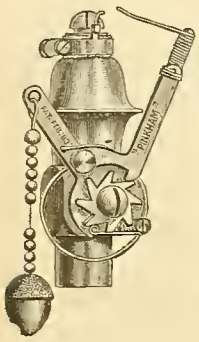

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Only one pair of brushes for each motor.

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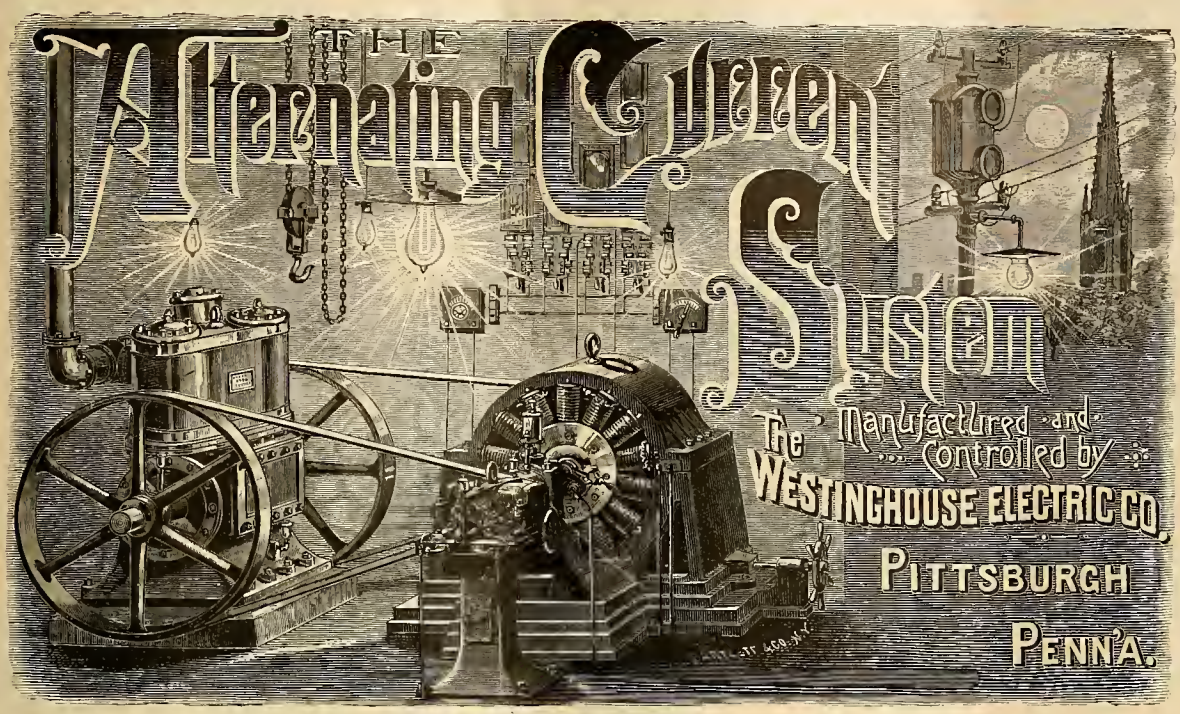

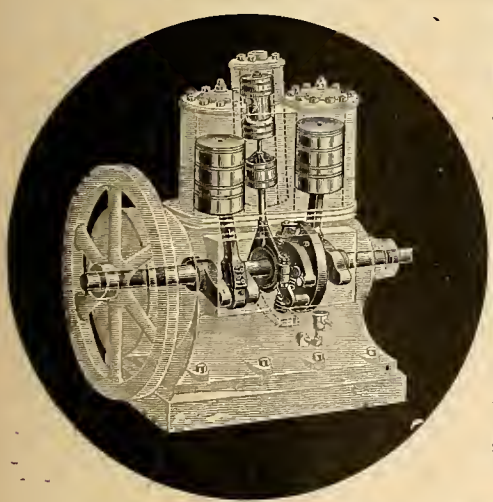

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EVERY SATURDAY.

Vol. III. CHICAGO, JULY 21, 1888. No. 3.

Death of Hiram Sibley.

The announcement of the serious illness of Hiram Sibley of Rochester, N. Y., was made in the last issue of the WESTERN ELECTRICIAN. His death occurred July 12th. Mr. Sibley's name will always be associated with the early history and the progress of telegraphy. He was a man of marked energy and business ability, and to the day of his death, at the age of 81 years, he was acquainted with every detail of his enormous commercial interests. He began life poor, without education, but endowed with a capacity for almost unlimited work. Mr. Sibley's interest in telegraphy dates from the beginning of its history. From the time of Professor Morse's first experiments, he had faith in their ultimate success. In 1840 he went to Washington and rendered important assistance in procuring the $40,000 appropriation, which enabled Professor Morse to build the line from Washington to Baltimore.

The early years of telegraphy were unprofitable to investors. The business was so divided, the companies experienced so much opposition within and without, so many rival instruments were in the field, that stocks were constantly falling. He then conceived the idea of uniting the companies and the patents in one new corporation on a strong basis. One of his first steps was the organization in 1848 of the New York & Mississippi Valley Telegraph company. The company adopted an aggressive policy. Soon the lines of the Lake Erie Telegraph company, running from Buffalo to Detroit, were leased and then purchased. Further consolidation led to the organization in 1854 of the Western Union Telegraph company. Mr. Sibley became president of the new company, and under his wise direction the business of the corporation increased with marvelous rapidity. The service was improved in accuracy and in rapidity.

It was Mr. Sibley's policy that the lines should be constantly extended, and for seven years the entire receipts beyond the amount expended for necessary expenses were devoted to this purpose. The result was that the stock speedily reached par, and in this way many magnificent fortunes were acquired. Under his management for sixteen years the number of telegraphic offices increased from 132 to 4,000, and the value of property from $220,000 to $48,000,000.

The project which Mr. Sibley considered the greatest triumph in telegraphy was the construction of a line to the Pacific. He presented a plan to the Western Union board, but the directors thought the scheme too hazardous. He decided then to push the project through by his own efforts if necessary. He applied to congress for assistance in the construction of a line which would enable the government to communicate with its forts, and afford the people of California a quicker mode of union with the east than by the long journey by Panama. An act was passed giving an annual subsidy of $40,000 for ten years. The most strenuous objections were made to the line, and Mr. Sibley found the greatest difficulty in inducing those interested in telegraphy to take hold of the project. As the expression was then, "Let Sibley go it alone." In spite of all the obstacles in the way work was begun on July 4, 1861. On the 15th of November, four months and eleven days after the commencement of the undertaking, the work was completed. In the "Telegraph in America" this comment is made on the achievement: "Its announcement was made with demonstrations of great joy. The papers were ablaze with congratulations and commendations of the vigor and skill which had brought the enterprise to so triumphant a close. To Mr. Sibley it was a day of triumph. The success was complete. It was essentially his work. In an important sense he had 'done it alone.' No man could rob him of his well-earned honor. He enjoyed it thoroughly."

Another enormous project which Mr. Sibley undertook was a plan of connecting Russia and America by telegraph lines by way of Alaska and Siberia. He visited St. Petersburg in furtherance of the project, and was magnificently entertained by the czar. The establishment of the cable rendered the project useless.

Mr. Sibley was reputed to be worth about $10,000,000, all of which he acquired by hard work and judicious investment. He had large amounts invested in lumber and salt interests and he owns nineteen farms, one of which, Burr Oaks, in Ford County, Ill., consists of 40,000 acres.

Mr. Sibley gave large sums for the erection of Sibley College of Mechanic Arts of Cornell University. In his office at Rochester were always to be found specimens of the handiwork of

HIRAM SIBLEY.

the students, which he was fond of showing to visitors. He was accustomed to say, "There are two most valuable possessions which no search warrant can get at, which no execution can take away, and which no reverse of fortune can destroy. They are what a man puts into his head—knowledge—and into his hands—skill!"

Mr. Sibley also gave the money for the erection of the library building of the University of Rochester, N. Y. It is said that Mr. Sibley remembered both Cornell and Rochester in his will.

Motors in England.

The production of motors in this country is proceeding apace, and although we cannot boast of the great development that has taken place in this branch of electrical engineering in America, where the factories for motors are as large as those for the production of dynamos, yet we can chronicle greatly increased activity, and the promise of the same development of large applications of this method of communicating power that has taken place in bygone years with other similar discoveries, says the London *Electrical Engineer*. The tendency in modern engineering is to larger and larger types of machines as our knowledge of their construction improves and the ability to build them to design without previous experimenting is attained. Sizes of electric motors, which would have been thought marvels a few years ago, are now ordered without much hesitation and manufactured without much difficulty, and we may confidently look to types of motors comparable in power to our large modern steam engine being satisfactorily produced as the demand for them arises. Messrs. Immisch are at present constructing two large motors for Messrs. Locke & Co., of Normanton. These motors weigh about four tons each, and will develop up to 75 horse-power when worked to their greatest power, though usually required for a regular output of 50 horse-power. The field magnets for these motors are of very large size, and for the double purpose of ease of conveyance and ventilation are made in separate sections. The motors themselves are too large to go down the shaft, at the bottom of which they are to be fixed, and will therefore be sent in parts and fixed together at the bottom. They will be used for hauling coal. The dynamos for supplying the current to these motors are of similar design, weighing a little more—namely, four and one-half tons. The dynamos will be fixed at the pit mouth, and the current connected by cables down the shaft. Two large motors have previously been supplied for pumping the water from the pit.

With series motors—that is, constant current motors in series with lamps—not much seems to be doing in this country at present. Isolated plants, where a constant current is used for arc lamps, do not seem to be, as a rule, much in need of a motor, and those stations running a constant current do not advocate the use of motors in series with their lamps, desiring to keep the light as steady as possible. Messrs. Immisch, however, have a type of constant current motor which they have manufactured in small quantities for some time; among others, one is running satisfactorily in the west of England, and one at Sheffield. This motor has an ingenious method of short-circuiting the current when the motor is not required. A pair of governor balls regulate by a lever arm a series of resistances, or rather the coils of the field magnets, and upon the speed of the motor falling the regulator touches a spring, which causes a copper bar to fly out and short-circuit the machine. * * * The question of where it would pay to use a motor, is one to which some attention should be paid. On the discovery of a new method of transmission such as this, many persons are naturally inclined, as occasion arises, to attempt a saving by the use of the improved method. It is only advisable in those cases where a distinct benefit can be produced. For an ordinary manufacturing shop, with a large engine in the basement, the cheaper way for the transmission of power to lathes, machines, or other apparatus, will be in most cases by the usual use of belts and shafting.

For a large shop to have a considerable number of small and comparatively costly motors scattered about, one to every machine, with its attendant necessity—even if slight—for care and inspection, would mean not gain, but loss. In cases, however, where an additional shed or factory is to be worked, and spare engine power is near, it is a question for consideration whether a dynamo, with a length of cable and a motor, would not effectively take the place of another engine with less outlay; and, of course, the familiar example of a factory at some little distance to a fall of water is another situation in which the use of a motor would be most advantageous. But there is usually no advantage in putting in a motor merely to take the place of belts.

De Bausset's Air Ship.

Frank Pearl in a communication to the New York *Sun*, writes as follows concerning the De Bausset air ship:

In an article on "Long Distance Ballooning," recently published, it is said that Mr. De Bausset proposes to build a balloon of steel and brace it internally sufficiently to resist the external air pressure when the internal air has been exhausted, and yet be light enough to float in the atmosphere.

I think that I can show that this is impracticable. Let us take a balloon of a spherical form, since that form will displace more air in proportion to its weight than any other form, and let d equal diameter of the balloon in feet, w the weight of the balloon in pounds, and w^1 the weight of air displaced by the balloon in pounds. If all the air in the balloon is exhausted, the weight of the air displaced, less w, will equal the floating power of the baloon. Now, a cubic foot of air at the level of the sea weighs .076 pound, and the atmospheric pressure on the surface of the exhausted balloon would be 15 pounds per square inch. We will assume the sheet steel covering of the balloon to weigh half a pound per square foot; that is about the weight of the lightest kind of tin in the market, and we will also assume that this can be welded together by the new process by means of electricity, so that there will be no riveted joints. We will further assume that 30,000 pounds shall be the maximum strain allowed per square inch on the steel struts.

The sectional area of the bracing necessary for each square foot of surface equals 15x144 divided by 30,000=.072 square inch.

The bracing to extend from the circumference to the center by primary and secondary bracing will weigh per square foot of surface .072 times 10 divided by 3 times d divided by 2, equal, that is, to 12 d. The weight of a bar of steel one inch square and one yard long, is very nearly ten pounds.

The surface of the balloon in square feet equals 3.14 d. Therefore the weight of the bracing alone equals 3.14 d square times .12 d=.38 d cube.

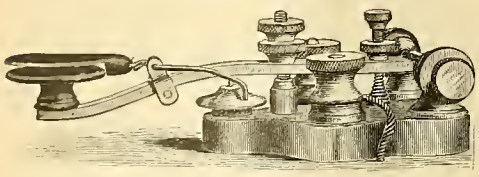
The weight of the sheet steel covering equals 3.14 d square times $\frac{1}{2}$=1.57 d square, and the total weight of the balloon or w equals 1.57 d square plus .38 d cube.

The cube contents of the balloon equal .5236 d cube, and the weight of air displaced, or w^1=.5236 d cube times .076=.04 d cube.

The latter or w^1 being much less than the former or w, shows the absurdity of the proposition. The weight of the bracing alone is nearly ten times as great as the floating power of the balloon.

Automatic Circuit-Closing Key.

The cut in connection clearly shows the design of this key. The switch is entirely done away with, its place being filled by the hard rubber disk



seen directly over the rubber button of the key and the mechanism in connection. When an operator wishes to send a message he presses down on the disk until it reaches the button, and thereby raises the ring from the other end, surrounding the contact point. The weight of the fingers keeps the disk down to the button, making disk and button practically one button, but as soon as the fingers are removed from the disk, the force of the spring causes the disk to rise and the other end to fall until it reaches the ring surrounding the contact point, thus closing the circuit. It is claimed this arrangement has a tendency to prevent writer's paralysis, inasmuch as the key spring is adjusted at two points.

The South Bend Automatic Key Closer company of South Bend, Ind., manufactures this key.

The Chicago Electric Motor company has been incorporated with a capital stock of $30,000. The company will manufacture electrical appliances. The incorporators are R. H. Garrigue, J. C. Scroggs, J. H. Claswell and H. S. Tiffany.

Fire Alarm Signal Box

In connection are shown illustrations of a new fire alarm signal box, invented by S. A. Chase, electrician of the United States Electric Fire Alarm company, of Evart, Mich., which possesses the meritorious features of simplicity, durability and perfect adaptability to the purposes for which it was designed.

The chief object sought in the invention was a signal box of such construction that by the insertion of a key of especial design an electric current could be established, and an alarm sounded. Fire alarm circuits are normally open, and in the construction of this box the inventor provided for keeping the circuit open until the insertion of a key closed it and caused the alarm to sound. The inventor has further provided for the reten-

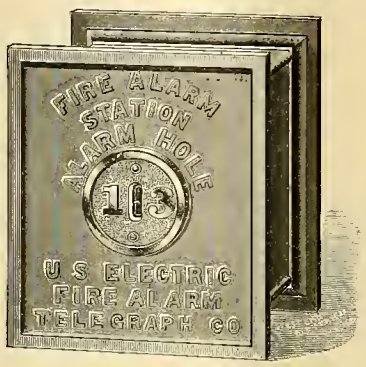


FIG. 1.

tion of the circuit-closing key until the box is unlocked by another key, carried by one in authority, thus protecting the service against the maliciousness of evilly-disposed persons.

Fig. 1 is a perspective view of the box which in practice is about four by four and one-half inches square by four and one-half inches deep. The circuit connections to the box are made through the back, which is fixed to a wall or baseboard. On the face of the box is seen the slit through which the circuit-closing key is inserted when an alarm is to be sounded and the figure "13," which designates the number of that box or station. When the circuit-closing key is inserted, the alarm is given; the simple insertion, without any turning of the key, is all that is necessary, and the key cannot be withdrawn until the box is unlocked by another key in the hands of one in authority, who alone carries it. This part of the mechanism is not shown. The unlocking key is inserted in a hole in the under side of the box, and a turn releases catches that hold the box to the base. When the box is unlocked, the face and sides which are cast in iron in one piece can be lifted off, the circuit-closing key retaining its position and the face of the box slipping past the key. When the shell, as it might be termed, is lifted off the base, a block, containing the mechanism for closing the circuit, is displayed, with the circuit-closing key in the end. The key can then be turned and taken out of its position, thus opening the circuit. The shell is then replaced, locking itself automatically, and the box is ready for service again.

Fig. 2 represents a longitudinal section of the box taken centrally through, and shows clearly the mechanism of the interior. A represents the back of the box which is formed or provided with a projection or flange a, and has suitable holes for the passage of screws 1, 1, for securing the box to a wall or other support. B represents the cover or casing of the box, the upper and lower sides of which are notched at the corners as at b, so as to permit of a portion of all of the sides being received by the flange a of the back A, thus concealing from view the supporting screws 1, 1, and rendering it difficult for effecting unauthorized removal of the box. Secured to the inner side of the back A are two blocks c, c, of wood or other equivalent non-conducting material, between which is arranged and secured on an intermediate block d, of similar material. The intermediate block is shorter than the others, and the latter are each provided with an inclined channel or recess e, the two forming between them a flaring or bell-shaped opening f, to admit of the necessary movement or play of the circuit-controlling springs and their attached insulator blocks. C C, represents the circuit-controlling springs, which are attached by screws, as shown, to the corresponding sides of the upper and lower blocks c-c. These springs have fitted to or secured upon their outer or free ends, a block D of rubber or other insulating material, the blocks being formed with an opening g, reaching to the springs, and having also in their tops at the forward end a beveled opening h, acting to receive and guide the circuit-closing key when it is inserted through the key hole in the front of the casing of the box. When the key is inserted between the insulated blocks held together by the springs C C, the end makes contact with the springs, and at the same time is caught and so held that it cannot be turned or withdrawn.

The Book Table.

TELEPHONE TROUBLES AND HOW TO FIND THEM. Fourth edition; published by C. H. Haskins & Co., Milwaukee. Pamphlet, 32 pp., 16 mo. Price, 10 cents.

The fact that the fourth edition has been called for tells the story. It is a simple little book, adapted alike to the wants of telephone users or telephone exchange employes.

Order of Railway Telegraphers.

To the Editor of WESTERN ELECTRICIAN:

ST. JOSEPH, MO., July 9.—In your issue of June 30th, you quote the Order of Railway Telegraphers at our annual convention held in Indianapolis last month, as opposing the postal telegraph. Please allow me to correct that statement. As individual operators we are divided on that question, but as an order we wisely let it entirely alone, and at our convention when the subject came up it was promptly tabled.

In the matter of increasing the salaries of the grand officers the report should read that one year ago at our annual session an amendment to the constitution was offered increasing the salaries of the grand chief and secretary and treasurer from $1,000 to $1,200, which had to lay on the table for one year. When it came up this year, an effort was made to increase the amounts to $2,000 and $1,800 respectively, but being contrary to the constitution this could not be done, and the appropriation was accordingly made.

D. O. FREEMAN,
Sec'y of St. Joseph Div.

Electric Switch Lights.

By additions just made to the electric signal service of the Oakland mole the Southern Pacific company now have seventy lamps, each of sixteen candle power, at its switches and its semaphore signals. The coal oil lamps used in switch signals have been replaced by 38-volt Swan electric lamps. Only one-half of the lighting capacity, or eight candle power, is used in the lanterns, as it has been determined that the life of a single light—500 hours when

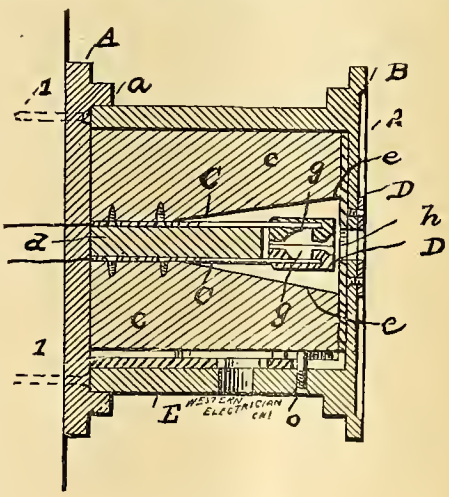


FIG. 2.

burned at full capacity—can be extended more than tenfold by this diminution of the lighting power. W. W. Slater, who has charge of the electrical system of the company, says that as compared with coal oil for switch signal purposes, electricity is far cheaper. The average cost of an oil lantern per month is 90 cents, which includes .65 for the oil and labor, and .25 for the depreciation of the value of the lantern. The electrical lanterns cost but 30 cents a month each, which represent the value of the coal used in generating steam for the dynamo. The signals are much more satisfactory to engineers than formerly, as they are clearer and are never extinguished by the wind. The new system is now complete between the pier and tower 2 at the Oakland end of the mole. A new signal tower, with the necessary apparatus, will probably be erected by the company near the Sixteenth street station, in Oakland, soon. Thirty new semaphore lanterns using electricity have just been put into service on the mole.

The Solution of Municipal Rapid Transit.[1]

By Frank J. Sprague.

PART I.

The presentation of this subject before the American Institute of Electrical Engineers for discussion seems to me most opportune. It is a question of great importance, and one for which a definite solution is fast becoming imperative. To those of us who believe that the solution is to be found in the application of electricity, it has a special significance, and I trust that what I say may bear fruit by starting a general discussion of the subject, not only among electrical men but the general public as well.

More attention is now being paid to the question of tramway traffic than ever before. The reason is not only the comparatively high cost of operation under the present almost universal system of horses, but also because the public are beginning to feel and the street railway men are beginning to see that it is a system behind the times. Laying all humanitarian questions aside the public demand a better and a more rapid service. Railway men want to give it, provided they can do so for the same or less money than they are now spending.

To quote from a New York evening paper:

"The rapid transit question has steadily pressed its way to the front of subjects demanding immediate attention, until it now stands in this city the foremost question of the hour.

"The fact is made evident by the eager discussion upon every hand of the very best means by which the end may be attained with the least possible delay. The total passenger traffic, that is, the total number of persons carried, of this city, has increased at the rate of over 140 per cent. in each period of ten years since 1866, and is now something over 325,000,000. At the same rate of increase it would amount in 1890 to over 500,000,000, and in 1900 to 1,225,000,000."

There is every reason to believe that the through traffic will increase as much as expected, because the city is growing rapidly and its business section is continually enlarging and pushing northward, forcing the larger part of the population, especially the laboring classes, to seek homes in the upper portion of Manhattan Island and the Annexed District, where rents, already increasing because of the increased facility of access, are still lower than can be readily commanded for business purposes in the lower part of the city. The elevated roads of this city, although carrying 500,000 people a day, do not answer the requirements of rapid transit, either local or through; nor is it possible for any two-track railway to do so.

By rapid transit we do not mean merely through transit; we ought not to consider alone the methods of transportation from one end of the city to the other, or from the city to the suburbs; we are likewise called upon to find some means by which the local traffic shall be benefited. Everything which lessens cost of operation, increases speed, reduces intervals between cars, increases the number of cars and makes extensions possible, aids rapid transit, no matter whether surface, underground or overhead.

With the same cost of operation, provided the motive power is materially cheapened, a greater number of cars can be run, intervals can be shortened up, large cars can be run in the place of small ones, better attention can be afforded, cars can be better heated, lighted and cleaned; they can make better time, people can be carried further for the same money, branches can be opened in districts which would otherwise not pay, and what is all important, more passengers can be carried, and for this reason alone more money can be made. For years an attempt has been made to replace the horse with motors of various descriptions—compressed air engines, fireless engines, hot water and soda motors, naphtha and petroleum engines, and steam engines. But we can safely say that the question has to-day narrowed itself down as between the cable and the various electric systems for surface work, and between electricity and steam for elevated or underground work.

In order that we may be in a better position to judge of the comparative economy and the relative advantage of present and proposed methods of traction, I will briefly consider, first, the use of horses.

Two distinct methods are recognized among street car men in the handling of their stable equipments. In one, the stock of horses is kept as low as possible; they are worked hard, making fourteen or fifteen miles a day, and the depreciation is very heavy. In the other the stable equipment is increased; the horses are kept in excellent condition; their average daily duty is reduced to ten or twelve miles, and the depreciation is lessened.

Assuming the cost of a horse as $150, and the cost of feeding and caring for him as $180 per annum, it would seem that any accurate knowledge of the average life of horses under different days' duty would soon determine the proper amount of the latter.

All railway returns do not, strange as it may seem, give accurate information on which such estimates of cost can be made; but from such facts as are given we may deduce the following: Taking the returns for 1887 for the five largest roads in Massachusetts, we find that they show 6,909 horses and 1,410 cars; that the mileage made was 12,834,665, and the passengers carried 76,187,842.

Dividing the average daily mileage by the number of horses, and multiplying the number of horses in a team, we find only 10.26 miles as the average daily duty for all teams, sick or well. Horses which are on duty make from 12 to 14 miles.

On the West End road of Boston, which is now the largest street railway combination in the world, having about 212 miles of track and over 8,000 horses, 10 per cent. of the horses are counted as being off duty from illness, sprains, shoeing or other causes; and the balance of the horses average about 12 miles a day. A car day is estimated at 10 to 11 hours, and from 45 to 50 miles, and eight horses are allowed as the active force.

The rule given me by one of the officials of this company as a fair one to determine a stable equipment is, to divide the total daily mileage by the miles made in a car day and multiply it by nine, adding what is necessary for hill horses. Hence, if fifty miles is a car day duty, a daily run of 1,600 miles would require a stable equipment of 288 horses, besides those for hill work.

On the Fourth avenue line in New York, the stable equipment is determined as follows: A car day is 11 hours, and eight horses make about five trips, aggregating about 50 miles. To this number is added 10 per cent. for illness, sprains, etc., and 10 per cent. for emergencies. On this road is illustrated the influence of an important factor in horse car work—that is, the position of the stables. Horses from the upper stable are limited to 11 miles, or otherwise they would have to make 22 miles, while horses from the lower stable have to make 13½ miles, or considerably more.

The average cost of motive power per car day throughout the United States, that is, for from ten to eleven hours and trips aggregating from forty-five to fifty miles, is about $4. This counts only those horses on actual duty on the road. The cost of motive power per car day for equal mileage in Richmond is less than $2 on the heaviest sort of grade work. The total operating expenses of a horse railway average for the five largest roads in Massachusetts 25.15 cents., and for all the roads in Massachusetts 24.7 cents per car mile; and the ratio of operating expenses to gross receipts is, for all the roads, 86 per cent.

The cost per day per horse, based upon the returns of four of the largest roads in New York, is 54 cents, and the cost per car mile from 9½ to 10½ cents per car mile.

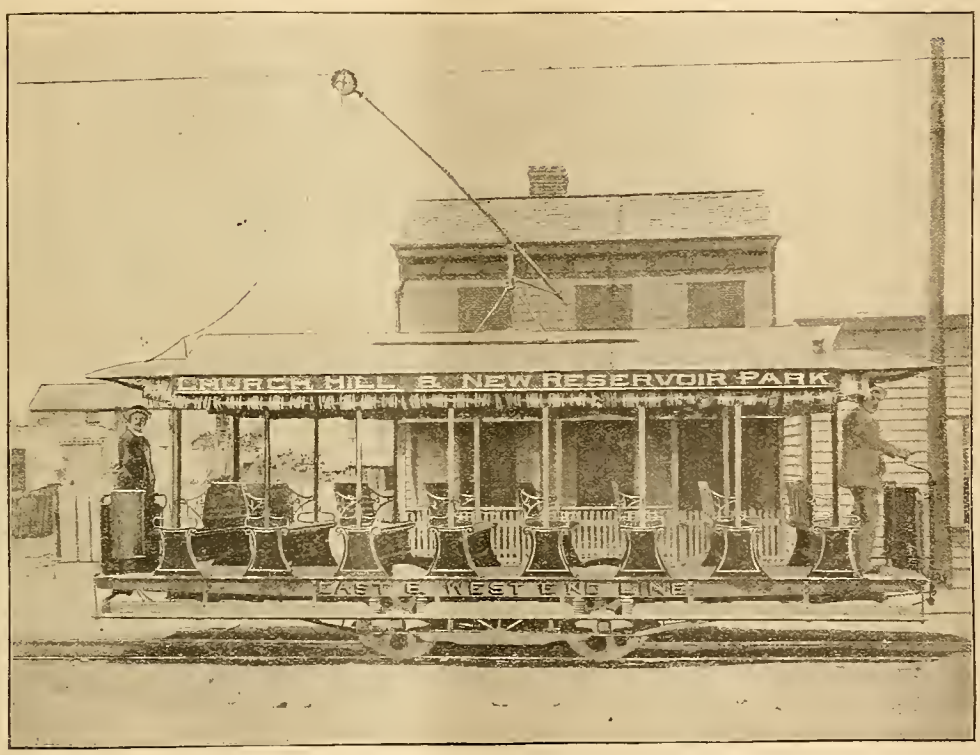
In addition to the regular depreciation there is ever present danger of an epidemic in hot weather.

Since the cost of motive power alone—that is, the cost of harness and stable equipments, horseshoeing, renewals, provender, hostlers, etc.—is 40 per cent. of the total operating expenses, it will at once be seen how vitally important any material saving in the cost of motive power becomes. If, as we claim, the cost of motive power in an electrical system is one-half or less than that in a horse system, the percentage of gross receipts available for interest and dividends is more than doubled.

Furthermore, when we remember that the average running time for horses is only five to six miles per hour, we have another reason which constitutes an unwarrantable objection to the use of horses for rapid transit.

Among the systems which have been proposed to take the place of horses and which has given the most promise, and met with the greatest success where heavy grades and traffic exist, is the cable system. With its general features you are probably familiar.

There are, however, a great many objections. One of the most serious is the great initial cost of the construction and plant, the cost of the conduit alone ranging anywhere from $50,000 to $80,000 per mile of single track,



making the investment so large that none but roads having heavy traffic can permit of the expense.

The conduit is necessarily large and costly in order to accommodate sheaves of sufficient size to prevent too great a loss in friction, and on account of the position of the cable and pulleys it is difficult to clean it. This large size also makes it difficult to construct a conduit which will not, because of the traffic and weather strains, be distorted and have the slots forced together or apart. The depth varies from two to three feet, more often the latter, and in any city street this is almost certain to interfere with steam, gas, or water pipes.

Each section of the line being a unit and operated from one cable, a break in the cable will suspend the entire traffic of that section.

A broken strand is apt to foul the grip and pile one car on top of another, as happened in Philadelphia, or suddenly start a car which is at rest, as recently happened on the 125th street line in this city. The cable is a heavy, cumbersome affair, 1¼ inches diameter, and weighs about 13,000 pounds to the mile.

It is found that it is best to make these cables in 20,000 feet length.

If a cable is stranded it cannot be used until repaired; if it is stretched 1 per cent. it is considered unsafe. These weaknesses of the cable system render it necessary to have a duplicate cable ready for instant use, and a double line of sheaves.

With a full load not over about 20 to 25 per cent. of the power of the engines is actually used for the propulsion of the cars, the balance being for moving the cable. With any light load the efficiency is even less. But it has been found advisable to have even greater power than this, most of the companies having from two to four times as much engine power as is required at any time, and from one and a half to twice the boiler power. This is necessary, because if any part of the cable engine breaks the whole section of the system is disabled.

Every turn in a cable brings a strain upon the grips and reduces the life of a cable, and any increase in the speed

[1]Read before the American Institute of Electrical Engineers, June 19, 1888

at which a cable is driven likewise shortens its life.

Difficulty exists in turning corners, expensive drums, and oftentimes auxiliary cables being required. Constant care and attendance is necessary in lubricating the carrying and curve pulleys, and in taking care of the slots and switches, the estimates for Boston being about $3.20 per day per mile of single track, requiring the time of one man per mile. It is impossible to work turnouts, crossovers or sidings without auxiliary cables, or to operate single tracks.

A line once being put in, any extension is expensive and difficult because of the terminal machinery which is necessary and the definite length of the cable.

The speed is limited; a car cannot travel faster than the cable and thus recover lost time, except on down grades; nor can it travel more slowly except by permitting the cable to slip. The regular speed then, must be the same in the most crowded sections of the street as in the less populated sections.

The starting is often with a jerk, and the whole motion of a lurching, unequal, unpleasant character, exceedingly disagreeable when first experienced.

Success in the cable railway system considered by itself depends largely upon the condition that a line of reasonable length shall be so located as to warrant frequent car service.

The chief advantages of a cable are, the cheapness, as compared with horse power, of operating a heavily patronized road at a comparatively fixed rate of speed with no regard whatever to grade or gravity; but this cheapness is not inherent to the cable system, but due rather to the fact that steam has such a tremendous advantage over horses.

The motive power operating expenses varies from 50 to 70 of the cost of operating by horses.

Now, what is it that electricity by some of its systems promises us for the ordinary street traffic? What are its advantages? First, it will do the work, and in a far more satisfactory manner and at a greatly lessened cost of operation than with horses. Electricity is simply an agent for which we have to pay a certain proportion to carry the power of our steam engines to take the place of the horse. Since not only on levels but also on the up and down grades an electric car can be run much faster than a horse car, and because it can be gotten under way and stopped much more quickly, the mileage with any given number of cars can be increased, the mean running speed increased, and the same time intervals made with a less number of cars; or, on the other hand, shorter intervals be made with a given number of cars. The equipment will occupy about 35 per cent. less space, the horse space being saved, and this fact, together with the ability to back when necessary, and to quickly gain headway, enables an electric car in narrow and crowded streets to work a passage through where horse cars would be at a dead stand still. Not only can cars run down grade faster, but also with much more safety, because of the possibility of the instant reversal of the motors in the event of the parting of the brake chain; and when arriving at the top of a grade, the faster a motor runs the better. It has not got to be held in to save it.

The riding of an electrical car is far easier than that of any cable or horse car, starting or stopping more easily, and being in a large measure free from lurching and oscillation. The cars are much cleaner. They can be brilliantly lighted, and they can be heated by electricity. There is no dust such as rises from the heels of horses. The sanitary conditions are entirely altered, and the health and comfort of the whole population is conserved. Stables with all their unsavory characteristics and the consequent depreciation so the value of adjacent real estate disappear. No sand if needed on the pavements, and the pavements are not so quickly worn out; often no center paving is necessary. It becomes feasible to operate branch lines, and also combinations of grades, curves, and ill-conditioned streets which would be prohibitory to any other system. It is not to be claimed that any one system of electric traction has all these advantages; but in some form or other they will be found.

It has been said that an extended system cannot be operated by electricity, that the lines may break down, that a large number of cars cannot be operated simultaneously, especially when bunched up, that wires burn out, that brushes burn up.

True, these things have happened, and in case of defective workmanship or carelessness they may happen again. Although electricity is a force of unknown nature, and we know it by its effects, it is folly to hold that whatever faults in machinery exist or accidents occur do not come within a very narrow and limited category; and powerful and mysterious as it is, and answering an impulse with the rapidity of lightning, it is at the same time the most tractable and law abiding agent with which we have to deal.

There is not a freak of which it is capable which we can not guard against. It has not an attribute of which we cannot make positive use. It has no power of damage which cannot be controlled.

The development of its application, the mistakes which have been made and the accidents which have occurred are but the milestones and guideposts of the highway to success.

Were it not for the occasional failures there could be no advance.

As a matter of fact there is no apparatus for the transmission of energy that compares in simplicity and efficiency with the dynamo-electric machine and the electric motor. There is no machine in existence which, when thoroughly and well built and decently cared for is less liable to get out of order, and will stand harder usage and greater variations of work, with a minimum of attendance and care. A motor has but one moving part, and that has a rotary motion. Its torsional effort under given conditions is a constant, and when properly built and proportioned some types have over a wide range the remarkable and unique quality of having this torsional effort vary as the square of the current used, a feature of marked importance in traction work.

As modern as the motor is, the peculiarities of all its phases are just as well known and capable of just as graphic representation and forecast, as are those of the steam engine. This can best be shown by reference to some curves which illustrate the characteristics of some of the Richmond motors, and have the same significance that an indicator diagram has for an engine.

For convenience these curves are plotted on both sides of the axis of X. The ampere turns on one leg of the field magnet are plotted as abscissæ. The curve $O\ A$ gives the characteristic of the machine when run as a series dynamo on a variable external resistance at 856 revolutions. $B\ C$ represents the equation of counter electromotive force with an initial electromotive force of 400 volts. I have allowed an increase in the actual resistance of the machine of 10 per cent. for heating and other causes. The speed of the armature, the miles per hour made by a car with the Richmond gearing, the tractive effort in pounds for one motor, and the horse power units are, for convenience, all laid off as negative ordinates. Equal units of horse power and torque are laid off as abscissæ, so as to make the maximum points coincident.

The first important curve which we have to get is the speed of the motor in terms of its current. We have the law that the speed is directly proportional to the counter electromotive force developed, and inversely proportional to the strength of the field. In other words, the speed curve $E\ D\ C$, in terms of the current, is plotted from the curves $O\ A$ and $B\ C$, and the speed for any current is found by multiplying 856 revolutions by the ratio of the ordinates corresponding to that current.

The next curve with which we have to deal is that of the work of the motor in terms of the current; that is, the curve $O\ F\ C$, which intersects the axis of X and at the same point as the curves of speed in terms of the current and the counter electromotive force.

A third and most important curve is that of the work of the motor in terms of its speed, which is the curve $O\ D\ G$ plotted from the curves $E\ D\ C$ and $O\ F\ C$, with the horse power units transferred to the axis of X as abscissæ. For instance, following the negative ordinate for 30 amperes, we find, at the proper intersection, a speed of 630 revolutions of the armature, or 4.82 miles per hour of the car; and, in the intersection of the work curve, that 11.65 horse power is developed. These two values give us the point S as one of the points of the work curve, and so on.

Referring to the work required to be expended on a car, we have from the formula—

$$\text{horse power} = \frac{w\,n}{335}\left\{\frac{k}{2000} + \sin o\right\}$$

where w = wt. in lbs.,
n = miles per hour,
k = resistance to traction in lbs. per ton on level,
o = angle of grade,

the work which is required for any grade, speed and weight. Hence for any given conditions we can plot the equation horse power $= a\ n$, and by its intersection with the curve $O\ D\ G$, find at what speed the car will be moved by the motors and what current is required if we know the gearing. On the other hand, if we assume that a certain load on a certain grade shall be handled, and we elect that it shall be done with a certain efficiency of the motor, or on a certain part of the work curve, we can draw the car curve for this intersection and then deduce the speed of the car and, from it, what must be the ratio of gearing to enable the car to be handled by the motors under these conditions. Four of such car curves are drawn—$O\ R$, which shows the maximum which could be moved; $O\ M$, which shows what can be done at 50 per cent. efficiency; $O\ N$ and $O\ P$, showing the equations which are constantly in practice.

In the actual computation 10 per cent. extra is allowed for losses from friction and so forth.

With the Richmond gearing, and a car equation of horse power $= 4.8\ n$, we would have a car weighing 14,700 pounds sent up a 10 per cent. grade at 4.82 miles per hour, and each motor would take 30 amperes of current. If the grade or weight were increased, the curve $O\ N$ would be carried toward $O\ M$; or if the ratio of gearing is changed, then, with the curve $O\ N$ in its fixed position, the weight of car or grade would be increased, although the speed of the car would be reduced. Other curves are shown, $L\ K$ showing the tractive effort of the motor in terms of its speed, and $O\ H$ showing the tractive effort in terms of the current; the tractive effort varying, of course, as the work divided by the speed.

The variety of problems which can be worked out from these curve sheets is very large, and they become of vital importance in dealing with any new work. Nothing could show more clearly the value of a mass of iron in the field magnets (as I have always held to be the proper method of building motors), and the exceptional qualifications of motors for tractive purposes. Any change in the switch or any change in the potential will vary these curves materially. One fact, however, is to be noted; no matter how the field may be changed, the speed of the motor at 50 per cent. efficiency is a constant.

The connection of the motor to the driving wheels has been attempted in a great variety of ways, and nearly every mechanical device possible has been used. Often the motors are carried upon the car body and connection made with the wheels, which should bear a variable position relative to the car, by means of friction wheels, sprocket wheels and chains, or by belts, ropes or wire chains with tightening devices. The motor armature has been mounted directly on the axle, and also hung on a frame between the axles, being connected to both wheels by cranks and side rods, necessitating equal speeds of revolution of the motor, armature and the wheels.

These methods are all crude and unsatisfactory. They are makeshifts and ignore the most important and essential facts which have been developed in car and motor construction. There is to my mind only one good way to connect a motor, and this is to center the motor upon the axle, supporting it flexibly from the car body or the car truck, and driving by gearing with one or two reductions according to the service which is demanded. This is the only way in which an absolutely safe and positive connection can be depended upon both for ordinary work and for the normal and sudden strains called for in emergency.

Properly made, the friction of this method of reduction is very low, the motion is smooth and free, and reasonably noiseless.

The proposition to couple the motor so that it shall make the same number of revolutions as the axle ignores one of the most important points which makes light weight in motors possible, and that is the high speed at which the armature can be run.

I have pointed out, in describing the curve characteristics of a motor, one of the essentials to determine the proper ratio of reduction for any motor when required to do a given work. I may here add a brief formula, which will also serve as an index in this matter:[1] Let f equal the maximum velocity in feet per minute at which an armature at any time is allowed to travel; n the number of miles per hour to be made by the car; D the diameter of the car wheel in inches; d the diameter of the armature in inches,

Then the ratio of the gearing must be expressed by the equation:

$$R = \frac{f\,D}{88\,n\,d}$$

For instance, let $f = 4{,}000$, $n = 12$, $D = 30$ and $d = 10$; about the values which exist in street car work. Then

$$R = \frac{4{,}000 \times 30}{88 \times 12 + 10} = \frac{125}{11}$$

and this should be made in two reductions. As in our largest trucks, let $f = 4{,}000$, $n = 35$, $D = 42$ and $d = 18$. Then

$$R = \frac{4{,}000 \times 42}{8 \times 35 \times 18} = \frac{100}{33}$$

In the application of electricity we are limited to no one system; we have a choice which will permit us to meet any exigencies or conditions of traffic. There are two kinds of application.

In one each car is perfectly independent of the other, receiving its charge at the central station and acting as an individual unit. The storage battery method is such a system.

The other is a system of direct supply, and, unlike the battery system, where the energy of the steam is four times converted, it suffers only two losses. In this system the current is delivered directly to the line, from which the motors as they move along derive their current. There are several forms of conductors, center and side rails, the main tracks, conductors carried in conduits, and overhead. Either a complete metallic circuit may be used, or one conductor with the rail and earth return. The machines can be operated under three different systems—the series, multiple series and parallel circuit distribution.

Of these various plans, I shall discuss only three—the storage battery, the conduit and the single overhead wire system with underneath contact carried on the car, and for the systems of distribution the parallel circuit system only.

The storage battery from the time of its first introduction to the public has offered a tempting solution to the application of electricity for surface transit. The great advantage of the battery system is that while most of the advantages of an electric system are retained, such as perfect control of the car, ease of manipulation, cleanliness and so forth, each car in itself becomes an independent unit not dependent upon any general accident to a system. As attractive a solution as the storage battery at first sight seems, there are many points of disadvantage in the present state of its development. One of the most important is the excessive weight of battery which is necessary under the conditions of service which are met with in this country, from 3,400 to 4,000 pounds being the ordinary weight. Not over ten per cent. of lead in these batteries is actually used for storage. On account of the weight and the room which the battery takes up, there has to be a radical change in the construction of the cars, and while old cars can be made use of by a great deal of patching, it is not advisable to attempt this. This change makes the present cars useless, and likewise increases the cost of new car bodies.

Then again, while the tracks as they exist may stand the additional weight of motors on a four-wheel car, the additional weight of battery, making the total weight on a given wheel-base double what it was before, will render it necessary on a great many tracks to relay the road bed, or to put in 8-wheel cars. Of course these objections are not so serious on a new road as they are on an old one.

But I confidently expect to see, in the not so very distant future, the weight of battery necessary to handle a car reduced one-half; this, besides overcoming some of the objections which exist now, will halve the expense of handling them at the central station, and will also allow the present standard width of aisle to be maintained.

The present excessive cost and unknown depreciation of the battery, its lack of efficiency, limited capacity, the fact that only a portion of the charge can be taken out with safety, and the reduction of its output when sudden demands are made upon it, are all of such a character as to leave wide room for improvement. The loss of efficiency in conversion I do not esteem of such vast importance, because, in any large system where the engines are kept going under a steady load, the cost of operation will not be so very much more than where operating under continually varying loads. The limited rate of discharge, as well as the limited capacity, limits the grade work to which a battery car can be subjected. For instance, as batteries and cars are now made, we can easily have the following combinations of weights:

	Pounds.
Weight of car	5,000
Batteries	3,600
Motors and other apparatus	2,000
Sixty-five passengers	9,100
Total	19,700

To start and to accelerate this load on, say a 6 per cent. grade, demands a discharge rate which no storage battery company cares to recommend.

As near as it is possible for us to get at a correct estimate, on a new road of moderate grades a storage battery system could be operated at about 80 per cent. of the cost of operation by horses. This is about double the cost of the direct system of supply on a large scale.

But the storage battery is not going to stand still.

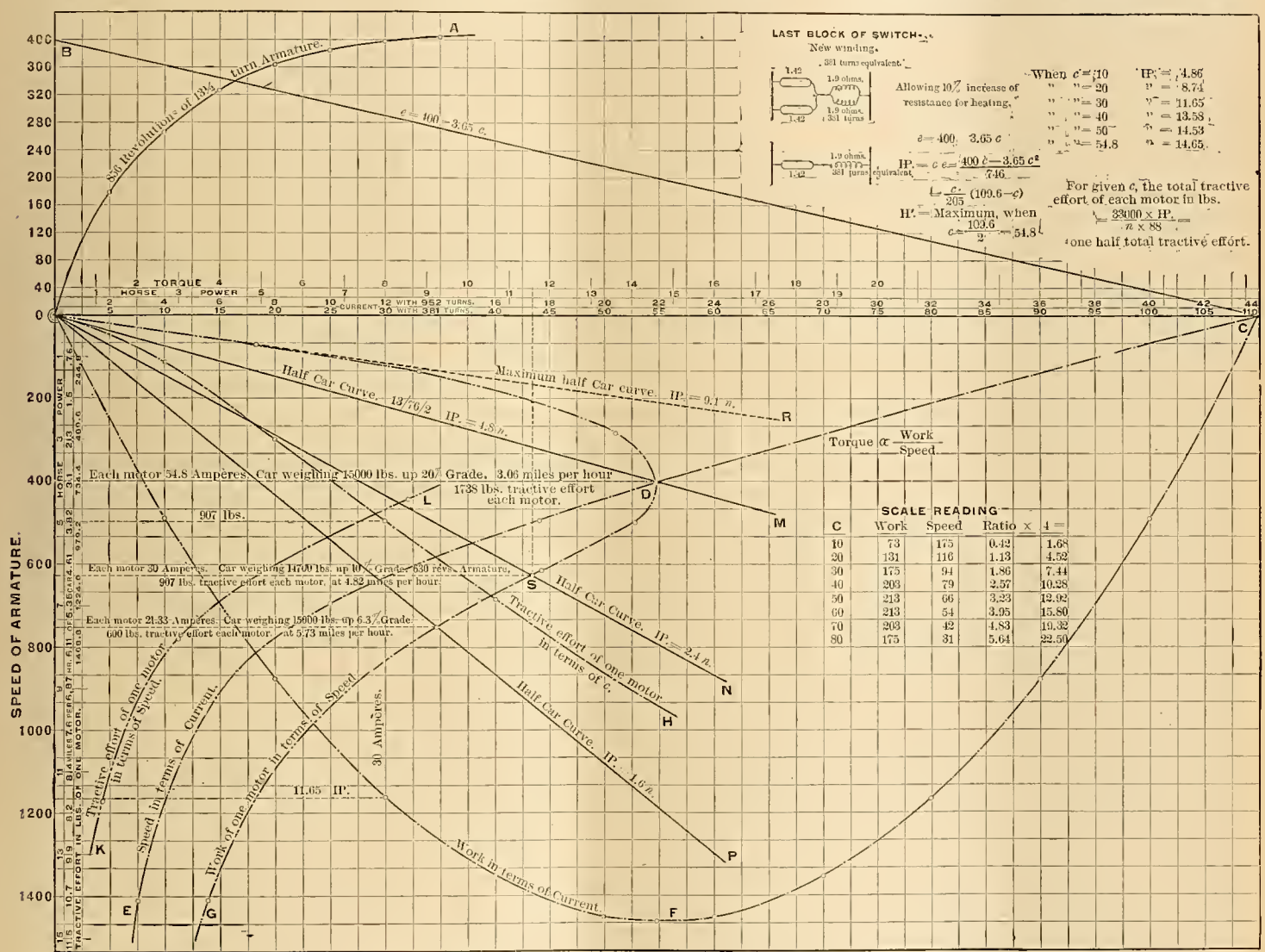
Many men with abundant capital are striving for improvement, and I think there is but little question that batteries will be reduced in weight, increased in capacity, and made far more efficient and long-lived.

The conduit and overhead systems have one point in common. Both are dependent upon a central station, and the actual cost of operation (except for the care and maintenance of the conduit itself) would be about the same. There is, however, a great difference of investment. Both must have about the same amount of copper, and to be effective, about the same distribution.

The difference of cost then is practically the difference between pole erection and conduit laying, and this will be from $25,000 to $30,000 per mile. As an investment of course it means that with the conduit very much more money has to be earned. The electrical conduit can be built for less money than a cable conduit, because it can be made of less depth, but it cannot be built without due regard to the strains of street traffic and weather, and with proper drainage and cleaning facilities. The advantages of the conduit are chiefly that there are overhead obstructions. Its disadvantages are, besides its great cost, the lack of cleanliness, increased possibilities of leakage, and greater difficulty of repair in case of accident. Recognizing, however, the demand which exists in certain places for a conduit, we have developed such a system which has many of the same elements of simplicity and reliability that our overhead system possesses.

The working conductor carried in the conduit is divided into sections, which at intervals of every block or half block, as desired, are connected through automatic cut-outs in manholes to the main conductor, which is continuous and inclosed in a lead or iron covered cable. Any accident to a section, such as flooding, short circuiting, and so forth, will simply cut out that particular block.

(To be continued.)



In the United States Circuit court in New York, July 13th, Judge Wallace handed down a decision denying the application of the American Bell Telephone company to have the private telephone of William T. Ketsell removed. The machine in question is in private use at the Hotel Madison, and Judge Wallace holds that there is no occasion for any such application.

In the article on "Electric Storage," page 4, No. 1, Vol. III., second column, twelfth line, "pressed," should read "passed," and in the tenth line of second column of succeeding page, "plates" should read "poles."

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CONTENTS OF THIS NUMBER.

PAGE

Death of Horace Sibley, with Portrait 25
Motors in England 25
De Bausset's Air Ship 26
Automatic Circuit Closing Key, Illustrated 26
Fire Alarm Signal Box, Illustrated 26
The Book Table 26
Order of Railway Telegraphers, Communication by D. O. Freeman, 26
Electric Switch Lights 26
The Solution of Municipal Rapid Transit, by Frank J. Sprague.
Part I. Illustrated 27, 28, 29
Editorial 30
Practical Telephony, by Thos. D. Lockwood, Part XII 31
Railway Telegraph Superintendents 32, 33

DEPARTMENTS.

Correspondence 33, 34
The Electric Light 34
The Electric Motor 35
The Telephone 35
The Telegraph 35
Electrical Patents 36

IN THE death of Alderman Thomas C. Clarke Chicago loses a councillor who was always on the side of progress. He was an earnest advocate of electric light for city illumination and to him in a large measure belongs the credit of establishing the plant which the city now possesses.

THE increasing demand for electrical apparatus of every kind is shown by the large number of companies which are formed every week. Some of these companies will exist probably on paper only, but a large proportion is formed with the object of entering actively into the electrical field.

LIGHTNING struck the insane asylum at Mineola, L. I., recently and played a number of queer pranks in the institution, chipping plaster from the walls and burning holes in patients' blankets. But the most singular fact in connection with the case is that the institution was struck by lightning forty years ago, thus disproving the theory that lightning never strikes twice in the same place.

IT seems from Mr. Freeman's letter that the report of the proceedings of the Order of Railway Telegraphers, in annual session at Indianapolis, Ind., published June 30th, was in error in announcing that the order had voted down a resolution favoring government telegraphy. As individuals, the operators are divided, and when the subject came up at the convention, it was tabled instead of being voted down.

IN the extract from Thomas Stevens' article published last week in which he gave an account of Persian telegraph operators, this sentence appears: "One or two have married American women, but by doing so have lost caste, much as a man does out west by marrying a squaw." This was the text of the original article from which the extract was taken. Since its publication Mr. Stevens has hastened to explain that the word should be "Armenian" instead of "American." This adjusts matters properly, and removes a terrible slur for which Mr. Stevens does not wish to be responsible.

NEW YORK'S Board of Electrical Control did not hold the sessions announced for last week on account of the death of a daughter of Secretary Moss. The final postponement was to Monday of this week. The importance of the subject to be discussed, that is, virtually, the comparative advantages and disadvantages of the continuous and alternating current systems, attracted many persons who were disappointed in the delay.

MUNICIPAL rapid transit is a subject of great and steadily increasing importance in every large city in the country. Frank J. Sprague took up the solution of the matter before the American Institute of Electrical Engineers June 10th, and we publish the first part of his paper in this issue. Without entering upon a comment on his paper, we will simply call attention to it, fully realizing that it will receive the most careful perusal from every reader.

THE USE and abuse of "Patent applied for" Commissioner Benton J. Hall proposes to curtail. As will be noted in our New York correspondence, he has issued a revision of the rules of practice in the patent office, and proposes to do away as far as possible with the practice some inventors have indulged in of postponing the issue of a patent, after establishing a right to it, meanwhile marketing goods protected by "patent applied for," and thus extending the life of the patent, in some cases, to even twenty-one years.

MANY of those who use the electric lights of the United States Electric Lighting company's arc lights in New York city have grumbled because the wires have not been put underground, but their grumbling ceased when the current was cut off a few nights ago, pursuant to the order of the Board of Electrical Control. The consumers then cared not where the wires were, so long as they were supplied with light. It requires such incidents as this to teach a great many persons that the electric light has become a necessity in the community.

MANY times a termination of the cable war has been confidently predicted by those who seemed to be in authority, and time has proven the predictions not well founded. Again it is announced that Messrs. Gould and Mackay have reached an understanding and have executed most of the contracts involved. There seems to be no question that the 12½ cent rate which has prevailed for some time was not a living rate, and that sooner or later it would have to be raised or the business of the companies suffer severely. The promise at the time of writing is for a doubling of the rate.

THERE is every indication of a prolonged fight between one of the electric light companies in New York city and the Board of Electrical Control. There is something to be said for each of the contestants. On the one hand, it is said that the conduits are not in good condition, and this view is taken by several eminent electricians. On the other side, it is urged that the overhead conductors are in a dangerous condition and should not be allowed to remain to menace the lives of pedestrians. This opinion seems to be held by almost every one not interested in the companies. The progress of the fight will be watched with interest.

THE New York *Sun* in a two-column article proceeds to give reasons for answering in the affirmative the question, "Has Brooklyn 'a gang' to check electric light competition?' In other words, reasons are given for believing that the two electric light companies which operate in the city, have made a deal with city authorities to prevent any other organization from obtaining a franchise. The statements are based on complaints of the Brooklyn Edison company, which has tried in vain to obtain a footing in the city. The two companies as well as representatives of the city government indignantly deny that any deal to strangle competition has been effected.

IN the death of Hiram Sibley of Rochester, N. Y., another pioneer in the telegraphic field passes away. He was a man of remarkable executive ability, of great perseverance and tireless energy. His efforts in uniting bankrupt telegraph companies resulted in an organization which gave to the country the first reliable telegraphic service. Although he amassed a fortune by his labors, the country was a larger gainer than he. Although 81 years of age at the time of his death, he was active in business to the last.

THE SEVENTH annual meeting of the Association of Railway Telegraph superintendents, was held in New York last week, and we present a very full report of the proceedings of the convention.

Commander Brown gave an interesting description of the manner in which standard time is ascertained and transmitted over the various railway telegraph lines, and the formal paper on electric welding by Otis K. Stuart, which has especial interest to telegraph superintendents inasmuch as it is quite probable that electric welds will take the place of joints in lines, also attracted attention.

The committee who had in charge the proposed substitution of another character than the long dash for the cipher in the Morse alphabet, reported the results of their investigation and the association wisely concluded to make no change and discharged the committee.

Naturally, the system of train telegraphy on the Lehigh Valley road demanded the study of the association and it received its full share of the time at the disposal of the association. An important statement was made in the discussion of this subject, that all wrecking trains on that road have been provided with instruments and are in communication with headquarters until the wreck is cleared away and the train returns. This feature of train telegraphy is very important, and its benefits will probably not be more quickly or thoroughly appreciated than by members of the association who inspected the system.

The time and place for the next meeting were fixed for the third Wednesday in October, and Atlanta, Ga.

IN a recent article on women as inventors, the fact is pointed out that, while many inventions have been patented during the last six months by members of the fair sex, no electrical appliance is in the number. It is suggested that here is a field in which woman may exercise her ingenuity. Certainly she would be welcomed by her talented brothers. The New York *Sun* says on this subject: "There is one field of modern progress in which women might easily compete with men, but in which, with the exception of one medical device, no patent was granted to women during the period here written of. Hundreds of patents have been issued to men for improvements in electrical appliances, but there seems to be no woman electrician. Hundreds of further improvements and discoveries will doubtless be made. We are only just beginning to harness electricity for the benefit of the race. Is there any good reason why woman should not help put the bit in its mouth? If some of the young ladies who devote a good many hours a day to the practical working of electrical machines should devote one or two more to the study of what is now called electrical science, they might perhaps make for themselves something of fortune and fame. 'Some one,' Mr. Edison once remarked facetiously to a reporter, 'will yet tap the northern lights and use the current thus obtained to run the world's energies.' There seems to be no good reason why a woman should not do this, if any one does. It is true that only a very few of the inventors among men obtain fame, or even considerable wealth, in return for their inventions. To make money out of an invention requires business capacity as well as inventive talent; but it is certain that time, talent, energy, and capital invested in new inventions do produce, on the whole, enormous returns."

Practical Telephony.

By Thos. D. Lockwood.

PART XII.

The ailments likely to attack the receiving and transmitting elements of the telephone considered individually have already been pointed out in the preceding papers of this series. It remains to consider these features in relation with their auxiliary appliances.

10. Sometimes a singing is heard in the telephone, as it is placed to the ear. This may be due to electrical changes occurring on the line, or on the other hand, it may be caused by something going on in the local circuit of the transmitter. Only experience can enable a man to tell at once, to which of these causes, any special disturbance is attributable. But it is gratifying to note that it does not require a large dose of the said experience. If the humming or singing be loud, raspy, and subject to frequent change, it is outside; and after any one has once indentified the noise resulting from electric light or power induction; or the intelligently sounding clicks of Morse telegraphy, he will never mistake either for anything else. If, however, the singing is soft and gentle though persistent, and if though soft, it has a near kind of sound, it may be assumed that there is something out of the way with the local transmitter circuit, and this may be a loose connection; a collection of chemical salts at some joint arising from the use of chlorides in soldering; a defect in the battery; the use of too large a battery; or the repulsion of the transmitter electrodes.

There is nothing easier than the detection of this trouble. You will remember that the receiving telephone when in use is actually included in the line circuit. Keep on listening, and gently part the carbon and platinum electrodes with the fingers. A click will be heard at the moment of parting, and after that—if the trouble be in the local circuit—silence. If the noise keeps on while the electrodes are separated, the trouble must be looked for outside.

But supposing that the noise disappears, and that speculation is thus turned into certainty, we have now to hunt down the precise character and location of the trouble.

There are three points in the local circuit peculiarly susceptible to defect, and just as the strength of a chain, is measurable by its weakest link, so the efficiency of a transmitter is to be guaged by the condition of the local circuit at these three points, which are:

1st. The point of contact between the electrodes.

2d. The point where the battery circuit is open when at rest, that is, the switch contact.

3d. The battery itself.

Look therefore at these points. Rub a piece of very fine emery paper between the electrodes; clean the switch surfaces, and clean the battery. If after all this, the objectionable noise is still heard, change the battery, for the battery is the most prolific cause of this trouble, and the formation of white lead under the cap, in its first stages, is one of the most likely first causes in the battery which lead to such results.

There is not much more to say about the user's outfit.

If the distant converser can be clearly heard, but can't hear, it is to be recollected, that it is at least quite as likely that the fault is in the man as in the instrument. Be sure and find this out before you alter at all. A regular user may have a big bass voice and be in the habit of getting close up to his instrument, and then bellowing like the celebrated bull of Bashan. The man who looks after his telephone, aware of this little idiosyncracy, keeps this particular transmitter screwed up tight.

But Brazenlungs has a friend who has a voice low and gentle, and who roars as gently as a sucking dove. In accordance with the eternal fitness of things, our modest friend stands a foot away from the transmitter, which, being adjusted for a close and loud voice, of course fails to work. Don't alter the transmitter, but give Brazenlungs a lesson. Tell him that if he is fully determined to break the rules of the company by letting people who don't pay for it use his telephone, the way to do it well is to show them how to do it. That he must get his little friend to stand well up to the instrument and assume a courage, though he has it not; and of course, if the circumstances are reversed, Mr. Titmouse must in like manner be taught to teach his friend Brazenlungs to modify his ferocity, to stand off a proper distance, and to speak as if he could see the person he were speaking to, and not as if the said person were miles away.

Never forget that you always have a testing medium at hand in the person of the hand telephone quite independent of any condition of the transmitter battery. By this, the condition of the line may always be ascertained.

In putting up a telephone set in the first place, instead of placing the backboard flat on the wall, a good way is to first fasten up with screws or nails two stout cleats or pieces of wood a little less in length than the width of the baseboard, and about an inch and a quarter or an inch and a half square, and then to screw up the baseboard to that. By so doing, a recess is provided behind the baseboard, and between it and the wall, where wires may be run if wanted, and where the telephone book or subscriber's list may conveniently be kept.

Before finally fixing the telephone board on the wall, it is also well to consult the person who is going to use it about the height which will be convenient. In residences, for example, where telephones are more used by ladies than by any one else, they will usually have to be mounted lower than in business places.

It should never be taken for granted that a subscriber knows all about the telephone and its use. Too frequently I fear a telephone is set up and left without a word of instruction as to how it should be used. The man who does the work assumes that the new subscriber knows as much about the operation as he does—and indeed, sometimes he does—and without a word of instruction or advice how to work the instrument, off he goes, leaving the unfortunate new comer to work out the telephonic salvation as best he may. Now, I hold that, if there were more intelligent work put in in the way of properly educating subscribers, there would be much less dissatisfaction in operation, and the telephone exchange business as a whole would go along much more smoothly than it does in many places.

A new hand with the telephone should be instructed to ring smartly, and then to put the receiver at once to his ear; that he can talk through the receiver if his regular transmitter will not work; that it is *not* his duty to poke the transmitter diaphragm with a pencil, and that it *is* his duty to notify the central station at once if anything goes wrong. He ought to be shown that a distance of three inches or thereabouts is usually the proper distance between his lips and the mouthpiece; that he should not shout or whisper, but speak in his natural tone; and that the receiver ought to be pressed close to his ear.

It is also advisable to inform him of the idea and principle of central office work, and to persuade him to visit the central station.

There is no better way to get him to see that he is not the only man who has to be attended to, and that the young ladies at the central office have no time for fancy work and novel reading, occupations which the average subscriber has a rooted belief they are ordinarily engaged in. He should be told that when the operator informs him that a line is busy, she doesn't mean *his* line, but the line he has asked for; he ought also to be made to see the necessity for promptly answering his own calls, and that if he does his part well he is in fact aiding the general service; also, that if he has a boy or any one besides himself to answer his calls they should in turn be instructed how to do it. Tell him that the time will seem long while he is waiting for a connection, but get him to time himself with his watch once or twice, so that he can see that the delay is more imaginary than anything else; and he not only will never forget it, but will call the attention of others to it, and thus do good missionary work. It is not enough that he should be advised in the printed book that he has no right to allow Tom and Jerry to use his telephone. Call this to his attention. He will think no doubt that this is a hardship at first, but if you show him the necessity for the rule and for its observance he will probably grow to regard it as a wise provision for the interests of the subscribers. Let him see that some subscriber may be using his line, when some other subscriber having real business for him calls for him, and is of course told that his line is busy. Thus he is deprived of the communication with his friend on account of his good nature; or he himself calling another number may fail to get it for the same reason. It is evident that the rule is made for the good of the subscribers.

Another point which every subscriber should be taught at the outset is the absolute advantage of ringing off, for disconnection. If one thinks of it, what a reform in our entire central office practice could be effected if every subscriber could be relied upon to "ring off" every time. If this were done every time, there would be no more "damnable iteration" of the phrase, uneuphonious though uttered in dulcet tones, "Are you through?" there would be no more necessity for the operators to interrupt conversation at all, for they would soon learn that No. 619 or 827, as the case may be, always rings when he had finished talking. It will always, of course, be the duty of the operator to come into the circuit for the purpose of ascertaining whether the "ring-off" is absolute, or whether either one of the two that have been talking wish now to talk with a third.

Strange as it may seem, the operators soon learn from the character of the ring of a subscriber whether he has really concluded his business for the time or whether he wants some one else. Usually the disconnecting ring proper is much shorter and sharper than a ring denoting any other wish.

Another good point to instruct either a new or any other subscriber upon is the following: Quite frequently we will hear a subscriber comment in a grumbling way upon the price per annum which he has to pay for the luxury of a telephone exchange connection. Suppose for example he has to pay $100 a year. You tell him it would be a mighty poor office boy he wouldn't have to pay as much as that for; but the argument doesn't reach his business ear. Then you show him that it is clear that it pays him to expend this enormous sum, if it did not, he would soon dispense with the telephone; but you find that this argument too fails to appeal to his intelligence. He will say, "The fact that to keep up with my competitors I am compelled to buy your wares, is by no means a proof that you are not charging me too much." The real essence of his mistake would seem to be, that unless properly instructed, he confounds the telephone with the service. He can't see why he should pay $100 a year for an instrument which he is told only costs from three to five dollars. Let him once clearly comprehend that it isn't the telephone he is paying for at all; that a telephone would be of no use to him, set up and connected if he was not allowed to use it, and that therefore it is the use that he pays for; the power of calling up and conversing with any one of the two or three thousand persons who also rent telephones, and the matter is at once on a different basis. With this understanding he sees at once why he ought to pay more in a large exchange than in a small one. Why? Simply for the same reason that when he advertises, an advertisement that goes with the paper in which it is printed into the hands of 200,000 people is certainly worth more than one which reaches a constituency of 5,000. Carrying out the newspaper comparison, which is the best existing parallel to the telephone, you can easily get your subscriber to see—if he be a reasonable man, and subscribers usually are reasonable when well treated—that it would be just as proper that he should have his advertisement printed for a year for two cents, the price of the paper, as that he should get his service for the cost of the telephone, to say nothing of the price of the line, apparatus and maintenance.

And to inspectors and others who visit telephone subscribers, I would say, always be courteous. No matter what a subscriber says, preserve your temper, and be pleasant, and show him that you are there to help him; don't answer him in his own coin but stick to business, and soon you will be welcomed, and when a subscriber sees that nothing but pleasant words come from you, he will, ten to one, adopt your way himself.

(*To be continued.*)

Railway Telegraph Superintendents.

The seventh annual meeting of the Association of Railway Telegraph Superintendents convened at the Murray Hill Hotel, New York City, Wednesday, July 11th. The meeting was called to order at 10 o'clock A. M. by President G. L. Lang, of Boston.

The following members were present: G. C. Kinsman, Wabash Ry., Decatur, Ill.; F. W. Drew (Sec'y), C. & E. I. Chicago; G. S. Jones, Ill Central, Chicago; G. E. Simpson, C. N. & St. P., Milwaukee; S. S. Bogart, West Shore, Weehawken, N. J.; J. B. Shaw, N. Y. P. & O., Jamestown, N. Y.; C. W. Hammond, Mo. Pac., St. Louis, Mo.; T. J. Higgins, C., C., C. & I., Cleveland, Ohio; C. A. Darlton, R. & D., Washington, D. C.; N. E. Smith, N. Y. & N. H., New Haven, Ct.; E. A. Smith, Fitchburg Ry., Boston; J. D. Gibbs, Mo. Pac., Sedalia, Mo.; E. H. Herr, C., B. & Q., Chicago; A. R. Swift, C., R. I. & P., Chicago; H. C. Sprague, K. C., Ft. S. & C., Kansas City, Mo.; H. F. Houghton, Wabash Ry., Butler, Ind.; C. T. Williams, N. Y. C. & St. L., Cleveland, Ohio; C. E. Topping (now Supt. U. S. Express Company), New York; Robert Stewart, C. R. R. of N. J., Elizabeth, N. J.; J. Stenson, L. I. R. R., New York; J. W. Lattig, L. V. R. R., Bethlehem, Pa.; F. P. Cummings, N. Y. N. H. & H. R. R.; Horace Johnson, Grand Central Depot, New York; I. Cohen, H. & T. Central, Houston, Texas; H. B. Leonard, N. N. & M. V. Richmond, Va.; W. J. Holmes, N. Y. L. E. & W., New York.

The following new members were elected: A. E. Smith, New Haven; N. B. Patterson, Mattoon, Ill.; Robert Stewart, Elizabeth, N. J.; F. W. Wilson, Fort Wayne, Ind.; J. E. Duval, Ottawa, Ont.; W. B. Blanton, Dubuque, Iowa; J. A. Lockard, Atlanta, Ga.; J. G. Pinkerton, Amory, Miss.; C. H. Hopkins, Norwich, N. Y.

After the reading and acceptance of the report of the secretary and treasurer, Mr. Bogart, from the committee appointed last year to examine the various devices for recording the signals transmitted over telegraph wires, made a verbal report. He had examined the self-starting registers manufactured by different firms, and those of the Western Electric company and the E. S. Greeley & Co., would be included in the exhibit of those companies which, with many others, would be ready for inspection Thursday morning. It was the intention to have the register operated by an electric motor in lieu of a spring or weight.

President Lang, after announcing that the various exhibits would be ready for examination at nine o'clock next morning, introduced to the meeting Commander A. D. Brown, of the Naval Observatory, Washington, who, he said, would explain to them some of the features in connection with the distribution of standard time.

Commander A. D. Brown then addressed the meeting as follows:

I was not aware until a few moments ago that I had come here for the purpose of making any remarks before the association, but I am very much obliged for the opportunity of doing so, and will be very glad indeed to give any information in my power. With reference to "The distribution of standard time," I assume you do not care to know just how the time is obtained, and that your object is more to find out how it is distributed. I may say, however, that the time is found from the stars, and not from the sun. In fact, no regular astronomical observer uses the sun as a source of obtaining the time. In brief, our observations are taken every day. Every evening as early as possible the number of stars is observed, and the standard mean time clock is compared with the sidereal or star time clock on the chronograph. The following morning the observations are worked up, and a comparison of the two clocks again made. If there has been any great change in the barometer during the night, it is allowed for in the rating of the sidereal clock, as experience has demonstrated that the density of the air has a great effect upon the rate of the clock. The standard clock is allowed to run on from one year's end to the other without being touched. It is the practice with some persons concerned in time service to place weights upon the pendulum, or remove them as the case may demand; but with us this is not done, because the standard clock is not used to send out the time, but another clock called the transmitter is used for that purpose. This transmitter is used every day at 20 minutes of 12. The officer who is taking the observations informs the gentleman in charge of the time service of the results of his observations, and the latter then compares the standard with the transmitter by the chronograph, and having found how much the transmitter is out, manipulates the pendulum by slowing it down or hastening it, so as to make the seconds of the transmitter show the correct eastern standard time. At 3¾ minutes before noon, the switch connecting the clock with the distributing system is turned, and a signal is sent to the Western Union office. The means by which this is accomplished is briefly as follows: Two wheels are placed upon the seconds arbor of the clock; the one has sixty teeth cut in it with certain omissions; the other has but one tooth of a peculiar shape. As these wheels revolve they impinge upon certain springs through which a circuit is normally constantly passing. Upon the top of the clock case is an armature with a peculiar hook-shaped contact point, which as the circuit is broken through the spring, makes the circuit on the eight point repeater which distributes the signal. In this way, the break of the clock is changed to a telegraphic make. As the signals proceed, the last five seconds of each minute are omitted, and also the twenty-ninth second of each minute. In this way a distant operator is enabled to know what portion of the minute he is receiving, and he only has to listen until he misses one beat. When taking up the count, if he gets beyond fifty he knows that it is not the last minute of the signal. Should, however, his count stop at fifty, he knows that the next signal will be noon. At the observatory clock when eleven hours fifty-nine minutes and fifty seconds is reached, the switch is turned on to the connection with the second wheel, known as the "minute break," which as it revolves, impinges against another spring, and makes the telegraphic signal for an entire second. In this manner it is easy to recognize the exact signal. In connection with the distribution of time the observatory has adopted, after many years of experience and experiment, a system which it believes to be the standard. It is known as the Gardner system of controlling clocks. We have a line from the observatory to the various public buildings in the city, upon which are some 225 clocks. There are others also, connected with the same line, making a total number in operation of about 400. This system has been in operation about four years, and has given entire satisfaction. The clock is an ordinary eight day clock, containing its own motive power. The office of the electrical signal is merely to set it, the connection being made by means of an attachment to the clock. When the signal passes the hour, minute and second hand move to zero; in other words, the clocks in Washington show 12 hours, no minutes and no seconds at the exact instant that the same is shown by the observatory clock. The railroads have recently had their attention called to this clock, and it is now in use upon some of them. The Piedmont Air company, being on the spot, was naturally the first one to take it up. The first request was for a clock in their office. This worked so well that they afterward ordered a number, some thirty, I think, which are now in use upon the line in the train dispatcher's office, and I think Mr. Darlton will corroborate me in the statement that they have given entire satisfaction. It seems to me that there can be nothing more important to the railroads of this country than a uniform standard of time upon which they can depend, and it certainly must be a great comfort to any general superintendent to know that at the instant of noon by the clock of the observatory whence he derives his time, every train dispatcher's clock shows the same hour, minute and second.

In answer to an inquiry by the president Commander Brown said that the clocks in question could not be operated by the signals sent from all observatories. One of the clocks had been left at Altoona to be tested by the Pennsylvania Railroad, but it did not give satisfaction, as the signal stroke sent from the Allegheny observatory was not suitable for it.

The president stated that all the roads running out of Boston obtained their time from the Cambridge Observatory.

Commander Brown in reply stated that every observatory has a different signal, each from the other. The Naval observatory has had the railroad service in view for many years.

Mr. Jones of Chicago, then stated that the Limited Time company obtained its signals from three observatories, viz.: Washington, Madison, and Evanston.

Commander Brown said it was a very bad practice obtaining time from three observatories. This had been proved by experience at New York, where the local time service is in charge of Mr. Hamblet. At one time he received signals from five different observatories. He made a record every day of the error, and it was evident from looking at it that by taking the mean we should get into trouble.

Mr. Smith of New Haven, stated that there was almost invariably a difference of one second between the time from Washington and Yale observatories.

Commander Brown stated that in Washington they pay more attention to accuracy and details. At one observatory the weather may be cloudy, and at another clear. It is much better to take the time from one observatory and stick to it.

Mr. Jones of Chicago, said that the matter of standard time was assuming considerable importance in the West, and when a proper system was shown, it would be generally adopted. He was not aware whether it was safer to rely for accuracy upon the enthusiasm of professors or the competition developed between private parties.

Mr. Herr of Chicago, stated that he had been using for about four months eight self-winding clocks located at various points, which had been synchronized by signals from Chicago; lately, however, Mr. Pond had started a time company, and was receiving time signals from two observatories. He proposes to synchronize his business comprising different systems and clocks; it has been doing very well. They synchronize only when the variation is less than half a minute.

Mr. Darlton said that the Gardner clocks were in use on the Richmond and Danville line over an extent of 2,500 miles. They are set at noon each day. The signals are sent over the railroad wires from Washington. The synchronizing device may be attached to any clock at very small expense.

In reply to a question by Mr. Jones Commander Brown said that the transmitting attachment added to a fine clock did not retard it, as the work required was so very slight. The attachment is not connected with the pendulum. It is on the seconds arbor, but not in the train. Mr. Williams of Cleveland, thought that Professor Gardner's attachment required a very long contact on the sixtieth beat. The signal which they received from Washington was a very short dot, not even a Morse E. It should be as long as a Morse t. Mr. Jones inquired if the magnetic influence which caused variation in the rate of watches would apply in any case to clocks.

Commander Brown replied that there would be nothing of the kind in case of a clock. There was no doubt as to the variation in watches caused by magnetism, especially with watches used on a railroad. He had made a great many tests of the Giles anti-magnetic shield, and also the Geneva non-magnetic watches. The Giles watches performed as well as a watch could, so far as their protection under ordinary circumstances was concerned. The shield was not, however, a thorough protection under all circumstances. He magnetized all of them, but had to place them close to the poles of the dynamo in order to do it. The non-magnetic watch was not affected at all. The first he tested he could stop in a magnetic shield; the other sent to him he could not stop. The difference between them was explained by the fact that a steel fork was used in the mechanism of the first watch. The question is not yet settled as to how these watches are going to wear, as they have been in use but a comparatively short time. Unless we put a shielded watch very close to a dynamo it will not be affected by the magnetic influence. There is no question but that the Geneva watch is compensated for temperature. The balance wheel is made of two different alloys of palladium.

Mr. Leonard, of Richmond, said that he had made tests with the Giles shield, and had never found it subject to the influence of a Thomson-Houston machine.

Mr. Herr replied that in his test he had used the Ball dynamo, in which the field is much more intense than in the Thomson-Houston machine.

Commander Brown explained that compensation for temperature is very difficult to obtain. He had just finished testing forty chronometers which were compensated for a temperature of seventy degrees. The makers have told him that in respect to compensation they work in the dark. We cannot get a watch or chronometer that will run within a second at all temperatures without an auxiliary balance. Palladium has been used as a balance spring for chronometers with the idea that it would not rust, but the metal was not satisfactory as a spring. It does not act the same as steel, and its use for that purpose in chronometers has been abandoned.

The president inquired of Mr. Bogart whether the time signals from Washington were sent directly through the New York office to New England, or whether repeaters were used.

Mr. Bogart replied that the signals passed through four repeating points in the New York office.

Mr. Jones stated that in 1869, while at Albany, he carried on experiments for a year or two in conjunction with the professor in charge of Dudley observatory. They made up a metallic circuit of 2,000 miles, and they fixed the speed of the signals over this wire at 36,000 miles per second, 1-500th of a second being consumed by the movement of each armature in the circuit. Very careful observations were made. The armature time had to be taken into account, and if its movement was sluggish, the time occupied was more than 1-500th of a second.

There being no further discussion of the time question, C. E. Toppin announced that the Hon. H. Starin had extended to the association an invitation to visit Glen Island. Transportation had been provided for 120 guests, and the steamer would be at the foot of East Thirty-second street at 3:15 P. M.

The Long Island Railroad company had also extended an invitation to visit Manhattan beach. Superintendent Holdridge of the Woodruff Palace Car company had provided coaches which would be in readiness at Hunter's Point at 5 P. M. on Thursday.

The president announced that an invitation had been received from Henry Harley to visit the tunnel on the West Shore road and examine the working of the signal at that point.

Mr. Bogart stated that Superintendent C. W. Bradley would furnish an engine and coaches. The signals referred to were a new departure. They count every pair of wheels that goes on a block, and report the same number as they pass off.

The thanks of the association were voted to the various parties extending the invitations, and it was decided to inspect the West Shore signals on Friday. At 1 o'clock P. M. the meeting adjourned until Thursday morning at 10 o'clock.

Second Day's Proceedings.

The meeting was called to order at 10:30 A. M. by President Lang, who announced that the next railway business would be the report of the committee appointed last year to report upon the adoption of a substitute for the long dash now used as the character for the cipher.

Mr. Selden reported on behalf of the committee that they had conferred by letter. They had called upon representatives of all the telegraph companies, and presented symbols suggested by different parties. Every new character suggested, however, conflicted with something already in use. If the letters were made correctly by an operator no trouble would arise from the conflict of characters now used. A feeling existed among all persons identified with telegraphy that we should not make any change in the Morse alphabet. Upon motion of Mr. Bogart the committee was discharged.

A telegram was read from O. C. Green, N. P. R. R., calling attention to the fact that superintendents did not act promptly in reporting discharged men. A general discussion ensued in which the practice of reporting the discharge of operators through the secretary's office was commented upon by the different members. It was maintained that this system was not a black-listing scheme, as has been generally stated, but merely a system by which the records of applicants for positions would be determined without loss of time and voluminous correspondence. It was decided to make no change in the existing methods, but it was generally understood that the superintendents would co-operate with the secretary in distributing prompt information of this character.

The following officers were elected for the ensuing year: President, G. C. Kinsman, Decatur, Ill.; vice-president, C. A. Darlton, Washington, D. C.; secretary and treasurer, F. W. Drew, Chicago, Ill.

J. W. Lattig, on behalf of the Lehigh Valley Railroad, invited the association to make a trip to Easton over that line and inspect the working of the train telegraph in practical use. The invitation was accepted.

In reply to an inquiry by Mr. Selden as to their experience with the train telegraph during the blizzard last March, Mr. Lattig said that it was their only reliance for telegraphic communication for three days. All the relief and supply trains were governed through the medium of the train telegraph, and its operators were on duty night and day. A serious accident occurred at this time, and there was no other means of communicating with the wreck. The wire was broken once on Monday at Boundbrook by other wires falling upon it. Their experience had been that this system works better in stormy than in dry weather. The use of it for commercial telegraphing was gradually increasing. None

of the previously existing telegraph offices had been abandoned by reason of its introduction because the growth of business on the road required constantly increasing facilities. A gravel train had been equipped with the apparatus, which was engaged in the construction of an additional track. One hundred men were employed on this train, and during the first week one hour and forty minutes were saved by the trains obtaining permission to remain on the main line. Working time for this train has been saved every week since it was fitted up, and provided with means of constant communication with the dispatcher's office. All of the wrecking trains have now been equipped with these instruments, so that after being ordered out they are in communication with headquarters until the wreck is cleared away, and the train returns.

The committee appointed to fix the time and place for the next meeting reported in favor of holding it at Atlanta, Georgia, on the third Wednesday in October, 1889.

Messrs. Lockard, Lennard and Darlton were appointed a committee of arrangements for the next meeting.

R. W. Pope was granted permission to address the meeting in order to call attention to a misunderstanding which appeared to exist in regard to the work of the association. He alluded to the fact that the application of electricity to railroad work was continually increasing, and pointed out that it would be for the best interests of its members to give greater attention to these matters in order to make their meetings more profitable and keep abreast with the improvements which were continually being brought out. His attention had been called to this subject by the appearance of an article in the *Railroad Gazette*, describing an incandescent plant which had been introduced in the railroad yard at Oakland, Cal., for lighting the signal lanterns by electricity, which had proved to be more economical for the purpose than oil. He stated that a similar plan was in contemplation by the Pennsylvania Railroad company for the Jersey City yard.

A discussion followed upon this subject which led to the adoption of the following resolutions:

Resolved, That the chair appoint a committee of five on electrical information whose duty it shall be to disseminate matters brought to their attention by members of this association.

The chair appointed to serve on this committee Messrs. Lennard, Lattig, Bogart, Swift, and Higgins.

Resolved, That the chair appoint a committee of three who shall select subjects and writers upon the same, said papers to be read at the annual meetings.

The chair appointed as such committee Messrs. Herr, Selden and Lang.

G. L. Lang presented the following paper on electric welding, as being a subject of general interest to the mechanical departments of railroads, as well as the electrical.

Electric Welding.

BY OTIS K. STUART.

The process of electric welding, which was discovered by Prof. Thomson some eleven years ago, while lecturing at the Franklin Institute of Philadelphia, has been developed in the past two years to a far greater extent than is generally supposed. We started in with the welding together of small wires of iron and copper, and have been so successful in the development of apparatus that we are now able to weld bars of a very large size and of almost any shape or metal.

The principle involved is that of forcing through a conductor an amount of current which the conductor will not carry without heating. Any conductors when placed in abutment have as their point of greatest resistance the point of abutment or contact, and consequently it is at this point that the heat is first generated, and as is well known, this heat increases the resistance of the conductors at that point so greatly that more heat is developed at a remarkably rapid rate.

A consideration of the above facts will prove at once one of the advantages of electric welding, as practiced by Professor Thomson, namely, the localization of the heat to the points or point at which it is desired, thus saving an enormous amount of energy, which is usually wasted in welding with the forge or flame. So absolutely is the heat localized that pieces of iron three inches long and an inch in diameter can be welded together and then held in the hands for some time without any danger of burning, the only heat which is felt at all being that which is conducted along the metal to the hands after the welding is completed.

A further consideration of these facts will also demonstrate that it is possible by the Thomson process to weld any metal, including even those which melt at a very low temperature, such as lead, zinc and tin, and those which melt at enormously high temperatures, as for instance, irridium and platinum. Of course it goes without saying that we can weld any of the metals used in ordinary manufacture.

It is plain that if the heat is developed so rapidly, a very delicate means of controlling it must be provided, and we are glad to say that we have been able to provide arrangements for this purpose which are almost absolutely perfect. I am inclined to say absolutely perfect, for the reason that the control of the current can be made entirely automatic.

We are able to take a bar of inch iron four inches in length, raise it to a dull red in twenty seconds and hold it there for an indefinite period; to increase the heat to a bright red in a very few seconds, and hold it there; then to still further raise the temperature to a welding or vaporizing point in a remarkably short space of time; this indicates the delicacy of this apparatus, and I would add that no very great skill is required to operate the machine, a boy learning to weld iron and steel with great facility in a week or two. The time required to weld metals depends of course upon the power of the apparatus and the skill of the operator. We have made strong and practically perfect welds in half inch round wrought iron in six seconds, in inch round wrought iron in 45 seconds, and so on. Experiments have proved to us that the power required to weld is proportional, or very nearly so, to the area of cross-section of the pieces; this is true of nearly all the metals, though, of course, the relative resistance and welding temperature of the several metals may interfere with this ratio.

For welding small wires such as telegraph or telephone, and the smaller sizes of electric light and power lines, the power required is very small indeed, the momentum of heavy machinery being more than enough to effect the weld. In this connection I desire to say that we are now working to perfect an apparatus for welding telegraph, telephone and electric light wires, and lines of pipe on the line. Our experiments in this direction have been successful, and we now think it possible to construct an apparatus which will be capable of being moved about by one or two men, and which will make joints in wires correctly and durably, the energy used being supplied by storage battery or batteries, forming a part of the welding outfit. For repair work and in general construction it is our belief that this apparatus will be found very useful and effective; in fact, we hope to do away entirely with the ordinary solder and link joints used at present.

The cost of such an apparatus will be very slight, and there would be a small royalty of a definite amount per 100 or 1,000 welds, as the case might be. This policy of placing an apparatus on the market has been adopted, for the reason that our patents cover not only the apparatus for electric welding, but the art or process as practiced by Professor Thomson. It is hardly necessary to add that by the same process, we can solder, and braze, and anneal, and temper, and do other heating local or otherwise, which can not be done economically by present methods. All these operations can be performed with the same apparatus, though, of course, it is better to have machines specially constructed for particular work.

Mr. Lang stated that he had seen one of these machines in operation when a bar of cast steel and one of copper were welded together. One would suppose that the metal most easily fused would burn away before the other was brought to a welding heat This is not the case, however, and it is very simply provided against. The current is brought to the bars through clamps which grasp the bars near to the end to be welded, and the current is brought through these clamps. Where copper and steel are to be welded together, the clamp is placed about six inches back on the copper bar, while it is only about one inch from the point of contact on the steel bar. In this case the heat is diffused through a large body of the metal which is most fusible, so that they are both brought to a welding point at the same time. The process is something really wonderful, and promises to revolutionize the ordinary method. In reply to an inquiry by Mr. Lattig, Mr. Lang stated that the system is now in constant use at the Thomson-Houston factory in Lynn.

On motion of Mr. Lang, a committee of three was appointed to draw up suitable resolutions of thanks for the many courtesies extended to the association during their visit to New York City. The committee was composed of Messrs. Selden, Lang and Jones.

By permission of the meeting, F. E. Kinsman read a paper, describing an electric automatic brake-controlling device, which he claimed would make the existing air brake and block signal system still more effective than they now are

The paper was referred to the committee on electrical information.

The meeting then went into executive session and subsequently adjourned until October 16, 1889.

SOCIAL FEATURES

The members of the association and their friends visited Manhattan Beach Thursday evening as guests of the Long Island Railroad company: They were unfortunately delayed on their return trip by a mishap to another train, and did not reach New York until about 3 A. M. In consequence of this detention many of them did not feel equal to the carrying out of Friday's programme. A delegation started out, however, Friday morning, who were met at the West Shore station by S. S. Bogart, superintendent, and W. W. Montalvo, division chief operator of the telegraph system on that line, who escorted them to a special car where they were taken in charge by Henry Harley, superintendent of the American Railway Signal company, whose signals are in use at both ends of the Weehawken tunnel. The peculiar feature of this system for providing against accidents arising from the parting of a train on a block, renders it of special interest as adding another safeguard to the automatic electric signal; its operations were thoroughly explained. Transportation to Jersey City was provided over the Junction railroad and an elegant lunch was spread for the entertainment of the guests en route. A special car fitted up with the induction train telegraph apparatus for a trip over the Lehigh Valley road was found in waiting attached to the regular train leaving Jersey City at 1:16 P. M. J. W. Lattig, superintendent of the Lehigh Valley road now took charge of the party, and after passing Metuchen Junction an opportunity was given to the visitors to test the merits of the train telegraph. The length of time it has now been in use, and the record of the experience with it during the blizzard has greatly increased the estimation in which it is held by the Lehigh Valley management, and there is no doubt as to its practical utility, not so much for the convenience of travelers as for constant use in the administration of the affairs of the company. Although the perfect reading of the signals is somewhat difficult at the outset to an operator not familiar with the sound, those who have had very little experience with the instruments have no trouble in copying long communications as readily as with the ordinary Morse apparatus. The exhibition was highly satisfactory, and the party returned by the train leaving Easton, Pa., at 4:23, with a very good impression of the value of the system.

THE EXHIBITS.

The committee appointed at the meeting last year to secure and arrange exhibits of electrical appliances for railways did their work very thoroughly, and all being shown in one room, the display was very interesting. The following is a list of the exhibits:

The Non-Magnetic Watch company of America—Non-magnetic watches in great variety.

Giles Bros. & Co., Chicago—Large assortment of watches fitted with the Giles anti-magnetic watch shield.

The Western Electric company—Electrical instruments of all descriptions for railroad work, also a special self-starting register devised for use in dispatchers' offices.

E. S. Greeley & Co.—A fine display of key sounders, switches and measuring instruments, also a self-starting register.

Combined Electric & Trip Bell Cord company—A three-conductor bell cord for an electric train signal which can also be used as a mechanical bell cord in the ordinary manner.

The Pennsylvania Steel company—Crossing semaphore and automatic block signals, all designed to be operated by magneto generators.

Consolidated Railway Telegraph company—Two stations equipped in working order with induction train telegraph apparatus.

The Edison Phonoplex was also shown by working apparatus.

The Union Indurated Fiber company—Samples of buckets, pipe, and other articles, made of that material.

The Railway Cab Electric Signal company—A fine working model, with track and locomotives complete, showing the operation of the cab signal.

The Union Switch & Signal company—A variety of electric signals for switches, crossings, blocks, etc.

Chas. McIntire & Co.—Samples of the McIntire connector, as applied to wires of all sizes.

Waters-Sweeny Telegraph & Telephone Switch company—Telegraph switch, specially devised for the economy of battery material and office space.

Street Railway Signal company—A novel crossing signal operated by the jar of approaching trains.

CORRESPONDENCE.

New York Letter.

New York, July 14.—The meeting of the board of electrical control was adjourned over at two different times last week on account of the death of Mrs. Arthur Wallack, a favorite daughter of Secretary Moss. It is now announced for Monday, July 16th. There has been no meeting of the board for a long time, which has excited such general interest as this one, and there have been many disappointments to persons coming from a distance who were not aware of the postponements. During the interim between the meetings, however, the commissioners have been busy, and the attempt to dissolve the United States Illuminating company appears to make progress although the company's representatives show no uneasiness regarding the outcome of it, as they have been accorded various privileges by the authorities from time to time.

Benton J. Hall, commissioner of patents, has prepared and issued a revision of the rules of practice in the Patent office. The changes have been made with the object of preventing unnecessary delay in the issuing of patents. Hitherto under the law and the rules of practice, an applicant might after establishing his right to a patent, place his invention on the market as "Patent applied for," and by manipulation postpone the issuance of his patent for about four years, thus virtually extending its life to twenty-one years. The commissioner's revision will prevent as far as he is able, this evasion of the spirit of the law.

The brass working industries in this city are experiencing very dull times on account of the high price of copper. There appears to be so much uncertainty as to the future of the market that none of the manufacturers dare accumulate any great amount of stock, many believing the rise in prices is merely temporary while the demand for goods has been materially reduced in many lines where other metals may be used. In fact, if the high prices are continued it is very probable that some branches of manufacture will be discontinued altogether.

The East River bridge management is having a great deal of trouble with the new cable machinery recently put in by which they had hoped to increase the carrying capacity of the bridge railway. After several annoying delays in starting, the old cable broke and it was necessary to replace it with a new one, the operation consuming half a day, during which the trains were run at long intervals by locomotives. After new cables were put in it was observed that they began to stretch with use, and the old cable was patched up with about 200 feet of new, but this did not work satisfactorily, so it had to be removed. The new cables were then worked alternately until the following day when it was ascertained that the new cable by reason of the slack was cutting out the horizontal guide wheels on the Brooklyn section and another change became necessary.

The war of rates between the competing Atlantic cable companies has finally terminated, and most of the contracts involved have been executed. Messrs. Mackay and Gould have arrived at a thorough understanding with each other, and a notice of an advance in rates will probably be issued on Monday. The twelve and a half cent rate will be

doubled to begin with, and the question of another advance will depend upon the effect which is produced on the revenue.

A company, has been organized in Newark, N. J., with a capital of $500,000 for the general introduction of incandescent lighting. They have acquired from the Edison and the Westinghouse companies the exclusive right for the use of their respective systems, which will be used jointly; the Edison for the compact sections of the city, and the Westinghouse for the outlying districts and suburbs. The wires will be placed underground within the city limits.

The night watchman in the Real Estate exchange, 59 Liberty street, discovered the telephone box of the United States Illuminating company on fire about midnight on Tuesday. He extinguished the flames with a pail of water. The lineman, upon examination, found the telephone wire crossed with an electric light wire, the current from which destroyed the telephone and set fire to the box. P.

Detroit's Budget.

DETROIT, July 14.—About a year ago Judge Follett, treasurer of the Grand Rapids District Telegraph company, absconded. Since that time there has been trouble among the stockholders, and on Monday last the office was closed. The company will probably be reorganized.

The remaining $100,000 required to secure the water power canal at Sault Ste. Marie has been subscribed. The building of the canal will commence at once. The estimated cost of the work is $700,000 and it is expected to be completed within two years.

The underground wire ordinance relating to the Brush company was again before the court this week. It will be remembered as noted in these columns at the time, that the common council last fall notified the company to place its wires underground in accordance with the ordinance, failing in which the board of public works was to take the matter in hand and remove the wires, etc. The company carried the matter into court and secured an injunction restraining the city from interfering with its poles and wires, alleging that the notice of the council was insufficient and not in accordance with the legal requirements of the case. Another notice was served upon the company, and on Saturday last the city council or filed a motion for the dissolution of the injunction which motion was denied, as was also a request for leave to file an amended answer. The injunction will hold until the court has passed upon the evidence collected by the special committee appointed to examine into the practicability of underground systems.

The town of Port Huron was in almost total darkness Tuesday night owing to the destruction by fire of the Thomson-Houston station, operated by the Excelsior Electric company, who hold the contracts for the city lighting. The fire is supposed to have originated in the engine room and spread so rapidly that only a small portion of the plant was saved. The entire building, valued at $2,500, was gutted. In it were eight dynamos, two Ball high-speed engines, and one Westinghouse engine. All were badly damaged as was also a considerable amount of material in stock. The company estimate the loss, as far as known, at about $8,000. It will probably be a fortnight before anything like fairly good service can be given. A large force of men were put to work at once clearing away the debris and preparing for the rebuilding of the station. The company had closed a contract with the city for the year's lighting only a short time before the fire took place. The Electric Railway company also suffer from the loss of machinery and disruption of service. C.

Indianapolis Items.

INDIANAPOLIS, July 14.—Webster Chandler of the Gamewell Fire Alarm system was in the city last week. He reports a good business in his line, and quite a large increase in the south. He says he has just finished putting in a complete system at Birmingham, Ala.

There is one man in Indianapolis who is strongly in favor of an electrical street railway for this city, and he is honest enough to give his reasons. He is a jeweler and watchmaker. Says he: "All employes of the company and patrons will have to have their watches made non-magnetic if they want to keep them running." Through this he expects to realize many a dollar.

From all that can be learned the chances for an electrical railroad in this city in the immediate future are not as good as they were a month ago. The council in amending the charter allowing the use of electricity on streets originally intended to be operated by cable, has also amended the ordinance in such a way as to cut off some of the streets considered most profitable to the company. The officers here are unable to say positively what will be the outcome. The matter with a copy of the amended charter has been forwarded to the capitalists backing the enterprise. They have about two weeks yet in which to declare their intention, accepting or rejecting the terms.

Monday night's session was rather a stormy one. The committee on light declared their report not ready. This led to a sharp debate between friends of gas and electricity. The chairman of the committee stated they would be ready to report at next Monday's session.

Kansas Towns.

LAWRENCE, KAN., July 14.—About a week ago one of the armatures in the electric light plant of the waterworks company was destroyed by the lid of a tin bucket falling into it. A new armature was ordered immediately, and upon its arrival it was placed in position.

"The Lawrence, Gas, Fuel & Electric Light company," is now the name of the old gas company, and its capital stock has been increased to $117,000, all this being rendered necessary by its establishing an electric light plant in addition to the gas plant. The term of existence as denominated in the incorporation papers is 100 years. Among its directors are Washington Hadley of Lawrence, Wellington Lee of New York, and George A. Reynolds of Lawrence.

WINFIELD, KAN., July 14.—The telephone company, through J. L. Mulvane, its president, has communicated the intelligence to the council that the company has not made a cent in Winfield, and would be better off if it had never seen the town. This statement was made with a view of causing the council to reduce the occupation tax of the company from $50 to $15 per annum, the latter sum being the amount paid by the Western Union Telegraph company.

OTTAWA, KAN., July 14.—J. H. Hill, of the Santa Fe company, is arranging for the establishment of an electric light here for the illumination of the company's depot, yards, shops and hospital. It is understood that accumulators will be used in connection with the plant. C.

Kansas City, Mo.

KANSAS CITY, MO., July 14.—The electrical business in all lines remains very dull. All electrical men who can get away are hieing themselves to watering places and summer resorts.

The telephone company has run a cable from the central office to the new board of trade building. This makes twenty-five miles of cable now strung in the city. It is estimated that five miles more will be put up before the summer ends.

A copper wire circuit is being established between the exchange here and the one at Topeka. It will require 140 miles of copper wire.

Alderman M. D. Wood, superintendent of the Western Union Telegraph company in this city; George W. Brownson, chief operator; A. A. Hatch, Wheatstone chief, with their wives and familes, are spending the summer with friends in camp at Inglewood, a few miles east of this city. A.

Missouri Towns.

LEXINGTON, MO., July 14.—The proposition of Edward Obenroth, to establish an electric light plant in this city, provided the council would grant him permission to erect the poles and string the wires, has been accepted by that body, the ordinance committee to which the matter was referred having made a favorable report. It is thought he will use the Brush light. He has been in correspondence with representatives of that company and they will be here in a few days to investigate the subject.

PLEASANT HILL, MO., July 14.—In a fire here last week a number of the poles of the Pacific Mutual Telegraph company were burned and the wires destroyed. B.

THE ELECTRIC LIGHT

The Van Depoele Electric company of Chicago, has installed an arc plant on the excursion steamer John A. Dix.

The Midland Electric company of Omaha, Neb., are installing an Edison plant of 300 lights in the Omaha & Grant Smelting & Refining works.

The Mansfield, O., Electric Light and Power company have ordered a 45 light dynamo of the Western Electric company to meet the increasing demand.

The California Electric Light company of San Francisco, has ordered of the Thomson-Houston company of Chicago, a 50 light arc plant as an increase to the present plant.

The Englewood, Ill., Electric Light company has been incorporated with $50,000 capital stock. The incorporators are Joseph Badenoch, jr., John L. Badenoch and Charles T. Page.

The United States Electric Lighting company has begun an assumpsit suit for $40,000 against Cook county in the United States Circuit court. The county board refuses to pay anything more on the contract, having already paid $20,000 since informed by State's Attorney Grinnell not to do so.

The Western Electric company of Chicago has sold a 20 light arc plant to the La Grange Butter Tub company of La Grange, Ind.

The Excelsior Electric company, F. W. Horne, Western agent, Chicago, will install sixty arc lights and fifty incandescent lights in the store of John York, corner of Halsted and Nineteenth streets, Chicago.

Arrangements have been perfected for the introduction of the Westinghouse incandescent system into San Diego, Cal., and the plant has been ordered. The company expects the works to be running by October 1st. The initial capacity will be 1,300 lights.

A New Orleans dispatch dated July 16th says: The Brush-Westinghouse electric plant on Dryades street was burned this morning. The loss is estimated at $100,000. The city hall, parish prison, police stations and levee were furnished with light from this plant.

The Electric Improvement company will put up a plant for lighting the town of Willows, Cal. The Mather incandescent and the American arc will be used. The same company have purchased land at Santa Clara, and will at once erect a plant. Two boilers of 200 horse power, with two engines, dynamos, etc., will be installed, and arrangements will be made to double the plant a little later. The American system of arc lights and the Slattery long distance incandescent will be used. It is proposed to light both Santa Clara, San Jose, and the Alameda road.

The English parliament has passed the much talked of electric lighting act, and while the bill does not concede all that those interested in electric lighting desire, still it is agreed that it is a great improvement on the act of 1882. Of the new measure, *Industries* says: "On the whole, electricians, and especially electric light contractors, will have reason to be satisfied with the new act. If it does not give them all they asked for, it has certainly removed the greatest legal obstacle which has hithereto stood in the way of a public supply of electricity. It remains now to the profession to show that they are able to overcome the technical and financial obstacles to which we have alluded."

The test of the Egan battery and its application to the lighting of passenger coaches, made recently in Columbus, O., on the C., H. V. & T. road, was eminently satisfactory, and the Columbus gentlemen interested in the invention were greatly pleased with the exhibition of what the inventor, Charles E. Egan, has accomplished. A coach with the battery suspended underneath was attached to a train, and a trip made to Logan and return. During the entire trip a most satisfactory light was given. For a time, four 20 candle-power incandescent lamps were used, illuminating all parts of the coach. Later, two 30-candle lamps were substituted, with pleasing results. Probably the most pleasing experiment was with a single 50-candle lamp. This illuminated the car much more satisfactorily than any two ordinary coal oil lamps. A company is soon to be formed of Columbus capitalists, who will take charge of the invention and begin the manufacture of the plants in this city. They claim that it is cheaper than gas, and besides its novelty is certainly far safer in case of accidents to the train.

The National Carbon company of Cleveland, O., are sending out the following self-explanatory circular letter: "We have been endeavoring for some time to collect the material necessary to prepare a complete list of the users of arc lights in this country, showing the systems of arc lighting in vogue, and the number of lamps of each system. It is our intention to publish this information in pamphlet form, and to present it with our compliments to the members of the National Electric Light association, at the next regular meeting of the association, to be held in New York city in August next, or to forward it to such users of arc lights as shall apply for it after that date. We desire to make the list as complete as possible, and for this purpose we send to each name in our directory a blank report to be filled out giving the desired information. Will you kindly fill out the following blank at your earliest convenience, detach and return in the inclosed envelope, and as we desire to have the fullest and most reliable information obtainable a report of any change in your plant up to August 1st will be thankfully received, as well as the name of any new plant in your own or neighboring cities, so that we may send them a copy of this circular letter also." Those who have not received the blanks can obtain them from the National Carbon company.

Experience has taught the average New Yorker that electric light wires, like buzz saws, are dangerous things to monkey with, and it was a very discreet and respectful crowd that gathered about the lamp post on the southwest corner of Washington and Christopher streets at 6 o'clock last night to watch the sparks spitting like fire crackers from a Brush wire that a plucky policeman had fastened to the top of the lamp frame to hold it above the tops of the passing Ninth avenue cars, says the New York *Sun* of July 11th. A truck with a big tank on it had passed down Washington street half an hour before, and the wires that cross the street at that point, hung so low that the top of the tank caught two of them and broke them down. The next wagon had to be stopped till the driver got a ladder and propped the wire up to let his team pass under. When the next Ninth avenue car came along it was stopped by the police, and soon there was a big block of cars. Sergeant Granger of the Charles street station sent men down to clear the streets. The wires are leased by the East River Electric Light company, whose station is at 425 East Twenty-first street. They illuminate Christopher street from Greenwich avenue to the North River. A dispatch was sent to them by the police at once, notifying them of the trouble, but it was two hours before two men with the necessary tools put in an appearance to repair the wires. Luckily they were well insulated.

THE ELECTRIC MOTOR.

The Richmond electric road carried 17,108 passengers on July 4, 1888.

A commission has been appointed to fix the value of property to be acquired by the Electric railway at Rochester, N. Y. for its tracks.

The Sprague company have closed a contract to equip the Manchester street railway at Richmond, Va. This equipment will consist of ten cars and three and one-half miles of track on heavy grades.

The Sprague company have contracted to equip the street railway system, at Akron, Ohio. The equipment for the present will consist of ten cars and six and one-half miles of track, and it is intended to increase this very soon.

The Van Depoele Electric company of Chicago, has completed a power plant for the Rockford Electric Power company of Rockford, Ill. The generator will be 100 horse power and the motors will range from one-quarter horse power up to ten horse power.

The West Street Lake Union and Park Transit company of Seattle, W. T., will shortly purchase the plant for the road, including electric motors, cars and railroad iron. Current will be generated by a dynamo located at the central station, which will be at Lake Union. The line will be built to the west side of Lake Union, and will be extended ultimately to the canal. The road will be running next fall.

The electric motor is to be employed in the Metropolitan road in London. The engines now employed are of 450 horse power, but it is proposed that the motors shall be capable of developing 600 horse power. Secondary batteries are to be used and it is proposed that the storage capacity shall be sufficient for a run of an hour and a half. The experiment will be watched with interest on this side of the Atlantic. It is expected that a beginning will be made in October or November.

A dispatch dated July 15th, from Sault St. Marie, says: "The following officers were elected at the annual meeting of the St. Mary's Falls Water Power company: President, Joseph Clarke; vice-president, S. J. Corgills; secretary, E. W. Ellis; treasurer, William Chandler. The board of directors consists of W. W. Corgills, S. J. Corgills, Joseph Clarke, William Chandler, Otto Fowle, W. A. Stowell, E. W. Ellis. With the exception of Chandler and Fowle the officers are all from La Crosse, Wis. Contractors from New York, Boston, Buffalo, Toronto, Chicago, St. Paul, Minneapolis, and St. Louis are now here figuring on the construction of the canal."

The night of July 10th, the first electric car in Meriden, Conn., made a trial trip. Soon after 12 o'clock the car to be used was drawn out of the car sheds and placed upon the track in front of the office, and the party took their places. Those in the car were President George R. Curtis, Secretary C. L. Rockwell of the electric road, James D. Frary of Bridgeport, formerly of Landers, Frary & Clark of New Britain, D. W. Crippen and four representatives of the local press as invited guests, Chief Ford and Special Policeman N. C. Smith and Arthur Barker, John Barker, F. P. Higley, Martin McCormack, J. D. Kewell and A. Pease, all employes of the road. F. H. Strieby, F. H. Reed and W. C. Reed, representing the Daft company, managed the car. The car moved with great ease up grades and showed its capabilities. A local paper has this to say of the trip: In every particular the trial showed that the Meriden gentlemen to whose enterprise the city is indebted for the road, had made no mistake in adopting the plan that they have. The first trip was made under the difficulties of new machinery, a new motor and new car and it would not have been more than was to be expected, if some hitch had occurred under the circumstances. Yet there was not the slightest difficulty in any particular. The fact shows pretty conclusively the excellence of the system, and Meriden can shake itself by the hand in congratulation, provided last night's experiments are indicative of the future of the road.

THE TELEPHONE.

The American Telephone & Telegraph company of Illinois, has been incorporated with headquarters at Chicago. The capital stock is $10,000. The incorporators are Russell C. Whitmore, William Speirs and Albert R. Rawson.

The first telephone station under the control of the government has been that established in the Rotunda, says a Vienna correspondent, and steps have now been taken for the erection of six more stations in the city of Vienna itself. These will eventually be connected with the telephone exchanges in Baden, Vöslau, Wiener, Neustadt, and Reichenau. A project is also under consideration for the establishment of a long distance telephone system between Prague and Vienna.

Recently the telephone has been added to the safety service at the hospice on the Great St. Bernard. The travelers who intend to go over the Pass are now announced to the monks from the station in the valley below—a precautionary measure which has thus far been instrumental in the saving of six lives. In the last of these cases a house servant had been sent to meet the ascending traveler late in the afternoon. Night coming on and the two not arriving two more servants in company of two of the monks set out to meet them, and after a search of several hours found the missing two in the snow at a distance of two miles from the hospice. But for this timely help both would have perished.

Jonas Vestrom of Orebro, Sweden, who is making a tour in the United States, tells some extraordinary stories of the cheapness of telephone and electric light service in his native country if he is correctly reported. In the city of Orebo, he says, a place of 40,000 inhabitants, the annual rent of a telephone is $4 a year, and for that sum the subscriber has the privileges of a telephone exchange extending for a hundred miles outside of the city. In the city of Stockholm there are 7,000 telephones in use and every subscriber owns an instrument. The telephones in use there are made by the Erickson company of Stockholm, and Mr. Venstrom thinks that it is a better telephone than those in use here. He found that it was harder to hear or send a message a short distance in this country than to send it a hundred miles in Sweden. The cost of an electric light of the arc variety is about $6 a year.

THE TELEGRAPH.

A San Francisco dispatch says: Among the arrivals from Australia is Owen Jones, a prominent colonial engineer and capitalist. Jones comes accredited to the Canadian and American governments on a mission to conduct negotiations looking toward the construction of a trans-Pacific submarine cable. This project is regarded with favor in the Australian colonies and if subsidies can be obtained will probably be undertaken.

Statements made by Matthew H. Gray, a well-known engineer, who has been on a visit to Dr. George R. Ghiselin of this city, indicate that the laying of a telegraph cable across the Pacific Ocean, will soon commence, says the Chicago *Tribune*. Mr. Gray was sent to Vancouver, B. C., Australia, and other countries with which it is desired to secure cable connections as the representative of the Silverton Submarine Cable company of London to investigate as to the feasibility of the scheme, and he carries back a highly favorable report. It is therefore considered certain that the cable will be laid. It will run from Vancouver a some point in Australia, and is expected to cost £3,000,000 to £4,000,000. Mr. Gray sails from New York for England Saturday to make his report, and it is thought operations will commence at once. The Canadian government and people have interested themselves in the undertaking, as it is believed that such a cable would be of great commercial value to the Dominion. Property in Vancouver has materially advanced in anticipation of its influences.

A dispatch from New York says: There was an apparently well founded report last week that the cable war had been practically settled. Both Russell Sage and George Gould, speaking for the cable pool, which includes the Anglo-American, Direct, and Western Union cables, said that negotiations had been going on both in Europe and here for a restoration of rates, but that no agreement had as yet been actually signed. The impression in Wall street was that the negotiations had been carried on between the pool and the Commercial Cable company, these being the opponents in the war, but in fact there have probably been no such negotiations. The Commercial Cable company has never swerved from the position it took three years ago when the pool companies undertook to crush it. Some negotiations which have been had recently were, no doubt, between the Western Union company and two English companies in the pool. Mr. Sage said that the rate proposed as a basis of settlement is 25 cents a word. The present cut rate is 12 cents. The limit of the Commercial Cable company is 40 cents. The hope of the pool companies is 60 cents. The Western Union directors took no formal action as to advancing cable rates at their meeting July 11th. It is understood, however, tha the cable companies will make the rate two cents between their terminals, and the Western Union and Postal companies will add regular land-line charges to interior points. The present cable rate is twelve cents to interior points. The parties conducting the negotiations state that all the details have been arranged and only the formal action by the companies remains to be taken.

Miscellaneous Notes.

Thomas A. Edison and his immediate coterie of scientific co-laborers are anxiously awaiting the arrival of a package of phonograms from England, says a New York dispatch. They were expected by the Servia, but they didn't come and they are not here yet. Some three weeks ago Colonel Gouraud, the European agent for the phonograph, sailed from here for Europe, taking with him some of Mr. Edison's improved phonographs and several phonograms. On one of the phonograms was a message from Mr. Edison, on another a cornet solo by Levy, on a third a song by a local opera singer, and so on. Yesterday Col. Gouraud cabled Edison: "We have unbottled your voice and its echo resounded throughout Europe." Colonel Gouraud's intention was to get some remarks by Mr. Gladstone, Chief Secretary Balfour and other noted men, a song by Adelina Patti and some of the choruses sung at the Handel Festival, and these phonograms containing these words and music are now expected by Edison.

About a year ago A. H. Binden of Wakefield, Mass., secured a photograph of lightning which attracted a great deal of attention from the peculiar clearness and definition of the flash and the surrounding landscape, says the Boston *Post*. During the severe thunderstorm of last Saturday evening, between 8 and 9 o'clock, he succeeded in getting two photographs of the lightning. The flashes are of great brilliancy, and one of the pictures contains three or four distinct bolts, two of them crossing each other and throwing off streams of electricity in every direction. It is a most interesting picture as showing vagaries of electricity and proving the fact (before suspected) that the flashes have a sinuous or rotary motion, being twisted like a rope or ribbon during their progress to the earth. The cloud effects in the picture are also fine. The following extract is interesting in this connection. At a meeting of the Royal Meteorological society of London, the first report of the thunderstorm committee was read. The report deals with the photographs of lightning flashes, some sixty in number, which have been received by the society. From the evidence now obtained it appears that lightning assumes various typical forms, under conditions which are at present unknown. The committee consider that the lightning flashes may be arranged under the following types: 1. Stream. 2. Sinuous. 3. Ramified. 4. Meandering. 5. Beaded or charletted. 6. Ribbon lightning. In one of the photographs there is a dark flash of the same character as the bright flashes, but the committee defer offering any explanation of the same until they get further examples of dark flashes. As the thunderstorm season is now coming on, the committee propose to publish their report at once, along with some reproductions of the photographs by the autotype process, in order that observers may be prepared to notice the various forms of lightning.

A story of Senator Sherman's experience with the graphophone is told elsewhere. Following is a narrative from the New York *Sun*, detailing the experience of one of his colleagues: "Senator Eli Saulsbury, the crusty old democratic bachelor senator from Dover, Del., received a real surprise to-day, and one that gave his moral and physical nature a shock, from which he will not quickly recover. The old gentleman, who is not free from the American love of curiosity, heard that there was on exhibition in one of the committee rooms a new and perfect graphophone that was warranted to reproduce with wonderful accuracy any sounds committed to it. Mr. Saulsbury, who has the reputation of being a chronic doubting Thomas, gazed with great and growing interest at the instrument, and then asked to hear it talk. The operator adjusted the little cylinder containing the impression of words previously spoken into it, and requested the senator to apply his ear to the receiving tube. With eager expectancy he did so, but in a moment drew back with an expression of horror and disgust, as in shrill and exultant tones the automatic orator shrieked, 'Three cheers for Harrison and Morton! Hurrah! Hurrah! Hurrah! Tiger!'

The following dispatch comes from Newport, Ky.: Experiments here have resulted in an extraordinary discovery, if the statements made by those interested are correct. The discovery is that aluminum, which now costs $20,000 a ton, and is produced only in France, can be obtained anywhere by a most simple process, and at less than one-hundredth part of the present expense. The importance of this discovery can be judged when it is recollected that aluminum is the most generally diffused metal on earth, and has all the beauty of silver, besides being non-tarnishing, non-corrosive, more lasting than silver, with only one-fourth its weight. In addition, aluminum alloyed one-tenth of 1 per cent. with iron or steel increases the homogeneous and tensile strength of the metal nearly half, while for electro-plating purposes aluminum is superior to either gold or silver. The experiments began in an attempt to extract aluminum chemically from common clay and cryolite. This was accomplished in a novel manner, and the operators obtained thereby metallic aluminum, chemically pure. Their method was based upon the theory of substitution and smelting the ore in a water-jacketed steel furnace, a crucible being useless to resist the strong fluoride fluxes. When the mass was quite liquid it was conveyed into a converter, or covered slag pot holding about 400 pounds, and the aluminum extracted therefrom by a syphon tap. The slag was returned to the furnace, serving the purpose of a flux with more ore. This direct continuous process obviated the necessity of the usual costly intermediary elements, and made the aluminum about as cheap as copper.

Personal Paragraphs.

Emil Grah of Grah Bros., 194 Summit street, Toledo, O., was in the city last week.

D. H. Landerbach has resigned his position as general manager of the Chicago Edison Light company.

R. P. Valentine has been appointed superintendent of the Pasadena, Cal., Electric Light & Power company.

John Dick of Meadville, Pa., and David Hall of Houston, Tex., were guests at the Chicago Electric club, last week.

Israel Lovett, superintendent of the Midland Electric company of Omaha, Neb., made a flying visit to Chicago last week.

L. D. Wakeman has been engaged by the New York State agency of the Sprague Railway & Motor company to look after its interests in the city of Buffalo.

T. C. Hathaway, jr., of New Bedford, Mass., a graduate of the Massachusetts Institute of Technology, is under engagement with the New York agency of the Sprague Electric Railway & Motor company and is located in Central New York.

Edward Floch, inventor of the electric railroad signals while a passenger on the Staten island ferry boat yesterday, was stricken with paralysis, says a New York dispatch of July 13th. He was removed to his home in Richmond Terrace, L. I., and his life is despaired of.

Prof. Gray, who has been an assistant of Sir William Thomson, it is understood, has accepted a chair at Rose Polytechnic Institute at Terre Haute, Ind., and will enter upon his duties in September next. A full set of standardizing instruments for use in the institute, is now being made in Glasgow, and is said to be the finest ever brought to America.

William Tucker and Thomas Walker, farmers, were walking on the track of the Georgia Pacific railroad toward Riverside, a village north of Birmingham, Ala. A thunder storm came up and the lightning flashed frequently along the telegraph wires and the rails. Walker suggested getting off the track and taking to the woods. Tucker said, "No, if the lighnting is going to strike me, it would be just as apt to do so away from the track as upon it." Walker then left the track, but had gone hardly ten steps when Tucker was struck by lightning and killed. Walker was knocked unconscious. Just as he recovered, he was horrified to see the Georgia Pacific express thunder along and over Tucker's dead body, severing the head. Every bone in Tucker's body was found to be broken.

Business Mention.

The address of the new offices of the western department of the Sprague Electric Railway & Motor company is, Rotunda, the Rookery, Chicago.

Grah Bros. of Toledo, O., have the contract for fitting the Boody house of the same city with a Western Electric company system of return calls and fire alarm. The annunciator will have 136 numbers.

"We have already received a considerable number of orders for the ground switches illustrated in the WESTERN ELECTRICIAN last week," said Manager Terry of the Electrical Supply company of Chicago, "and we expect a large trade in them."

Chas. A Schieren & Co. of New York, report recent sales of their leather link belting to the following concerns for use on dynamos: Sheffield Electric Light company, Sheffield, Ala.; E. H. Johnson, Greenwich, Conn.; Hempstead Gas Light company, Hempstead, L. I.; Edison Electric Illuminating company, New Orleans, La.

Among the recent sales by the Sprague company are: One 25 horse power motor to run a grist mill in Scranton, Pa., and a 25 horse power motor to run a shoe manufactory at Brockton, Mass. The latter installation is being watched by the shoemen, and, as one of them said, "If this does the work satisfactorily, it will make a revolution in the shoe business."

The Western Electric company has issued a new electric light catalogue, which describes the various features of the Western Electric system of arc lighting with brevity and clearness. The success of this system and the satisfaction which it gives to its patrons is evidenced by a large list of users of apparatus. The list shows a total of more than five thousand Western Electric arc lights now in operation. There is an extended list of flattering testimonials from users of the system.

The New York state agency recently established by the Sprague Electric Railway & Motor company, with headquarters in Buffalo, is working up a large amount of business both in railway and stationary work. Its manager, E. E. Higgins, reports the interest in electrical transmission of power to be unexpectedly great, and the prospects for immediate work are very encouraging. Negotiations are now on foot for obtaining a supply of electricity in Buffalo, for general power purposes.

W. H. Adams of Reading, Mich., recently wrote the Woodbury Engine company, of Rochester, New York, as follows: "I would like your catalogue of engines. Please name price on a 20 horse-power, center crank, self-contained engine. Your engines do not need any recommendation to me, as I once owned one and ran a saw mill with it, and I think did the largest day's work ever done with the size engine. A brother of mine now owns the rig. It is a six-inch cylinder stationary engine, and I sawed with it in eleven hours 8,756 feet of hardwood lumber with four men. I can furnish good proof of this."

The Westinghouse Machine company of Pittsburgh, Pa., have issued a *brochure* devoted to their compound engine, mention of which has been made heretofore in this column. A most interesting fact is brought out in correspondence published in the pamphlet in a statement made by William Lee Church, as follows: "It may be interesting to know that the compound engine was designed by a process the reverse of the usual methods; that is to say, the first work was to lay out an indicator diagram, which should possess the highest theoretical possibilities. Such a diagram having been made and trimmed at until it was satisfactory in all respects, the drawings were next put in hand, and the proportions of the valve and the functions of the valve motion were planned to secure the results delineated on the card. As an evidence of the good understanding of the conditions of steam economy enjoyed by modern engineering, it is pleasant to note that the engine on its first trial described indicator diagrams which were almost the exact duplicates of the templates laid out. It is also interesting to note that the doing away of the intermediate receiver has almost obliterated free expansion between the cylinders. The coincidence of the back pressure line on the high pressure cylinder and the expansion line on the low pressure cylinder is also very remarkable."

The inventor of the Woodward plate is Dr. Henry Woodward, an English physician and scientist, says a Detroit paper, in an interesting two column description of the Woodward Electrical company, of which Frank B. Trout is superintendent. The great problem in storing electricity is to procure the largest energy in the smallest space. So much skill and research have been expended in storage apparatus that there scarcely seemed to be any chance for improvement in any of its parts. Dr. Woodward, however, invented a meritorious improvement in the plate. His plate is an ingenious affair. The company claims that it has more efficiency than any other plate in the market because it presents the largest red lead surface to the current. The plates are made by filling an iron measure of eight cubic inches inside measure, with coarse salt, which is baked. Melted lead is then poured into the measure, and the result is a solid cube of eight inches. This is sawed into slices about one-eighth of an inch thick, the surface of which are lead and salt. The slices are then immersed in water, which dissolves the salt, leaving them with perforated and irregular surfaces, like slices of a sponge. These interstices, when filled with the all important red lead paste, hold it in very favorable position for the action of the electricity and acid. The Woodward Electrical company of Detroit, which was organized last year with a capital of $1,000,000, is a parent company, which will dispose of its right to sub-companies, who it will also supply with the products made under its patents. The methods of storing electricity are the same in all the companies, the principal vibrations being in the character of the lead plate on which the red lead paste is placed, and which is the principal factor in the storage of electrical energy.

Electrical Patents.

Issued July 10, 1888.

385,705. Arc Lamp. James E. Gaston, Fort Worth, Tex.

385,727. Electric Motor for street cars. Wilber S. Salisbury, Chicago, Ill.

We give the last claim: "9. In a motor for street cars, the axle and one or more frames loosely journaled and supported upon said axle, in combination with one or more motors mounted on said frames, a gear connection between said motors and the axle, a pulley secured to the car frame, and a flexible or yielding guy rod secured at its ends to said frames and working over said pulley."

385,760. Electric Battery. William P. Kookogey, Brooklyn, N. Y.

385,770. Protector for Electrical Instruments. Geo. W. Mingle and William Mingle, Philadelphia, Pa.

385,774. Device for Lighting and Heating Cars by Electricity. De Witt C. Roberts, Chicago, Ill.

The invention relates to devices for lighting or heating by electricity cars which are propelled by means of a traveling cable located in a conduit beneath the ground, and more especially to means for establishing connection between wires or conductors located in the cars and conducting strips or wires through which the electric current is conveyed to the cars from a generating plant or plants located at one or more places on the line of a railway.

385,782. Electric Switch. Schuyler S. Wheeler, New York.

385,787. Electric Railway System. Edward M. Bentley, New York, N. Y.

The invention consists in a system wherein one section of a railway is provided with two supply conductors independently insulated and inclosed in a slotted conduit, while the succeeding section is supplied with an exposed single conductor, preferably elevated above the roadway and having a ground return.

385,815. Electric Switch. Junius E. Mayo, North Manchester, Conn.

385,826. Multiple Switchboard. Albert Sechrist, Greeley, Col.

The last claim follows: "3. A multiple switchboard having two or more rows of switches, each switch composed of parallel pivoted bars united by an insulating crossbar or handle, the bars being connected in different branches of the same electrical circuit, and sets of contact anvils or springs, one at each end of the bars, the sets being connected in the circuit of different sources of electricity, connections electrically connecting all the corresponding contacts from the sources of electricity in each row and connections electrically, connecting the corresponding parts of the corresponding switches in the different rows."

385,846. Wiring Switchboards. James A. Cook, Detroit Mich., and Frank B. Cook, Toledo, Ohio.

"Claim 3. The combination with the strips of spring jack switches arranged upon different multiple switchboards in the same order, of telephone lines, each connected with a different switch on each of the boards, the connections being made from the rear of the board, the wires for the connections being made up in cables extending horizontally from one board directly to another board, the cables being placed in layers, the different layers being adapted to be separated or crowded apart, whereby any cable may be removed with its attached strips of spring jacks."

385,863. Multiple Switchboard. Milo G. Kellogg, Hyde Park, Ill.

We give claim 2. "In a telephone exchange system, two subscribers' lines temporarily disconnected from the ground at the central office and connected together for conversation, with their calling annunciators shunted by wires of small resistance, in combination with a clearing-out annunciator in the circuit of said lines."

385,877. Railway Signal Lantern. Christian H. Peters, Danville, Ill.

385,894. Electrical Annunciator. Montraville M. Wood, Erie, Pa.

385,900. Automatic Weighing and Recording Apparatus. Edward H. Amet, Chicago, Ill.

385,902. Electric Railway. Edward H. Bentley, New York, N. Y.

"Claim 8. The combination with the contact trolley, of a conductor provided with a take-up device and a ring or eye by which it may be reached from below and brought into an operative position."

385,903. Switch on Overhead Lines in Electric Railways. Edward M. Bentley, New York, N. Y.

385,915. Electric Conductor. Leo Daft, Plainfield, N. J.

"Claim 5. The combination of the slide supporting the switch rails, locking devices, slide-actuating mechanism and buffers."

385,920. Railway Signal. Constant F. De Redon, New York, N. Y.

385,927. Coin-operated Induction Coil. Joseph W. Hazell, Baltimore, Md.

385,928. Electric Railway. Edwin W. Heald, Wilmington, Del.

385,943. Commutator for Dynamo Electric Machines. Frank B. Mitchell, Columbus, Ohio.

The improvement consists in constructing the hub of the commutator of hard wood, with insulating segments and conducting segments secured thereto, in making the insulating segments of glass, in covering and securing them in grooves or pockets formed in the hub, and in providing the conducting wires with an enlarged head and clamp and connecting the inner end of said conducting wire with a conducting plate of the armature, and clamping the outer end of said wire with the armature wire.

385,956. Electric Telephone. Nathaniel Parks, Deansville, N. Y.

"Claim 1. In a telephonic transmitter, an electrode, two other electrodes applied to opposite sides of the same, means for increasing the pressure of the first named electrode upon either one of the other electrodes and at the same time diminish the pressure upon the other branch circuits leading from the two outer electrodes and an artificial resistance contained in one of the branch conductors."

385,963. Railway Signal. Edward A. Sharp, Rogers Park, Ill

385,964. Electric Signal for Railways. Edward A. Sharp, Rogers Park, Ill.

382,974. Telephone Central Station Apparatus. Theodore N Vail, Boston, Mass., and John A. Seely, New York. N. Y.

"Claim 1. The combination of a central station, a series of sub-stations, a series of metallic circuits, one for each sub-station, connected in parallel at said central station, a telephone instrument for each circuit at the sub-station, a receiving telephone at the central station in a local circuit having fixed electrical contacts, two separable contacts for each metallic circuit, and a suitable device for separately connecting and disconnecting the two terminals of each metallic circuit with the terminals of the local circuit."

385,975. Telephone Sub-station Apparatus. Theodore N. Vail, Boston, Mass , and John A. Seely, New York, N. Y.

"Claim 3. At a telephone station a switch or circuit changer having a contact with the main line, a contact with a telephone branch, and a contact with a branch combined with a second switch or circuit changer having two contacts, the first connected to a generator of electricity and the second to the main circuit, whereby, when the second switch is operated, the generator and main line are connected during the process of calling, and preliminary to conversation."

385,976. Telephone Central Station Apparatus. Theodore N. Vail, Boston, Mass., and John A. Seely, New York, N. Y.

385,977. Telephone Central Station Apparatus. Theodore N. Vail, Boston, Mass., and John A. Seely, New York, N. Y.

385,978. Telephone Exchange Signaling. Theodore N. Vail, Boston, Mass., and John A. Seely, New York, N. Y.

385,984. Apparatus for Tilling Ground. Edwin R. Whitney, St. Johnsbury, Vt.

"Claim 4. In an electrical apparatus for tilling ground, the combination, with the carriage drawn by any suitable power and an electro-magnetic motor connected with electric source and a table or carrier on which same is mounted, of a segment of a cylinder, provided with spikes on its concave face, pivoted to main frame, and connected pivotally to end of said table or carrier, and a spiked rotary drum carried from ends of said segment and receiving motion from said electric motor."

386,045. Burglar Alarm. Richard H. Umbenhaur, Toledo, Ohio.

386,049. Railway Signal. George H. Wright, San Francisco, Cal.

386,059. Telegraphic Recording Apparatus Charles Cuttriss, New York, N. Y.

The last claim follows: "11. A rheotome consisting of a reservoir for holding mercury, a tube connected therewith, means for varying the height of the mercury in the tube, a circuit whose connections are controlled by the movement of the tube, and an electro-magnet connected in said circuit."

386,066. Electric Lock Frank J. Gridley, Chicago, Ill.

"Claim 1. In an electric lock, the combination, with an electro-magnet, of a bolt or a detent under stress and an electrical switch, said switch being adapted to break an electrical connection with the electro-magnet and close the same with another circuit adapted to extend the said circuit by the operation of the bolt."

386,071. Magneto Electric Machine William Humans, Cambridge, Mass

386,085. Electric Railway. Elias E. Ries, Baltimore, Md,

386,086 Driving Mechanism for Electric Railway Cars. Elias E. Ries, Baltimore, Md.

"Claim 1. The combination in a railway car of parallel supporting bars or frames extending between and sustained by the driving axles thereof, said bars being provided with openings provided with gaskets or rings for holding the electro-dynamic motor."

386,087. Combined Electric Railway and Wire Conduit. Elias E. Ries, Baltimore, Md.

386 088. Method of Welding by Electricity. Elias E. Ries, Baltimore, Md.

"Claim 1. The method of effecting union between two metals in contact, consisting in the application of heating currents of electricity to traverse the joint to be welded, and simultaneously subjecting said joint to the action of oxygen gas."

386,090 Electric Battery. Isaiah L. Roberts, Brooklyn, N. Y.

"Claim 1. The combination in an electric battery having the exciting material in the form of a paste, of a permanganate, bichromate of soda, and the salt of an alkali."

386,099. Automatic Cut-out for Incandescent Lamps. Merle J. Wightman and Hermann Lemp, Hartford, Conn.

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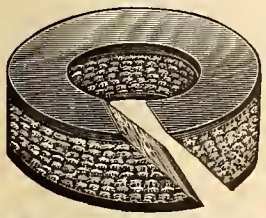

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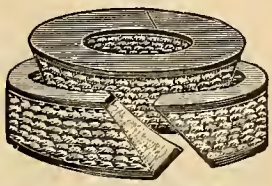

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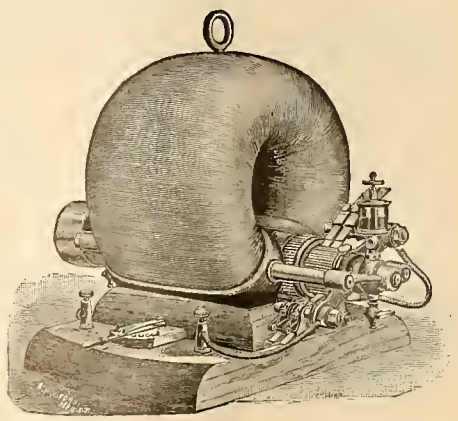

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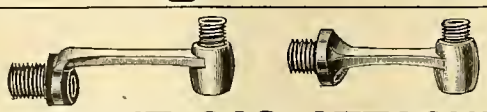

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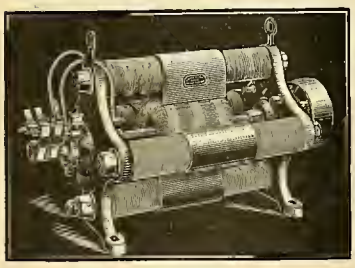

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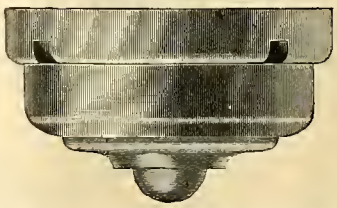

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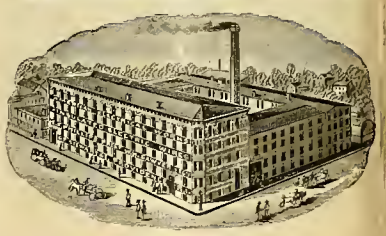

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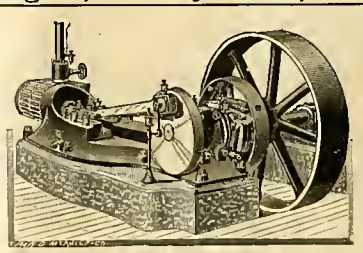

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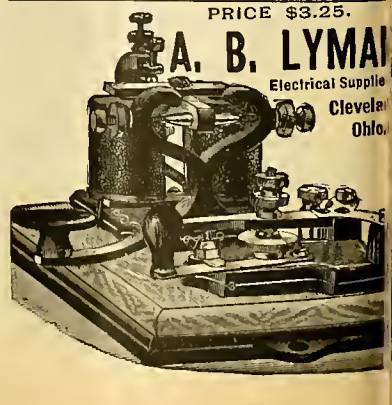

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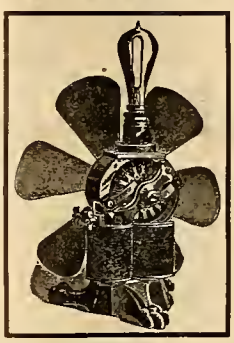

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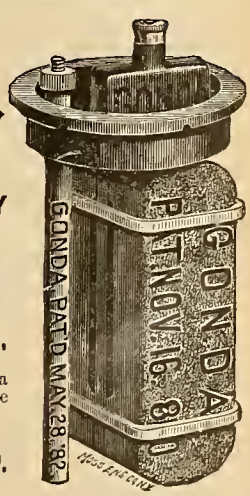

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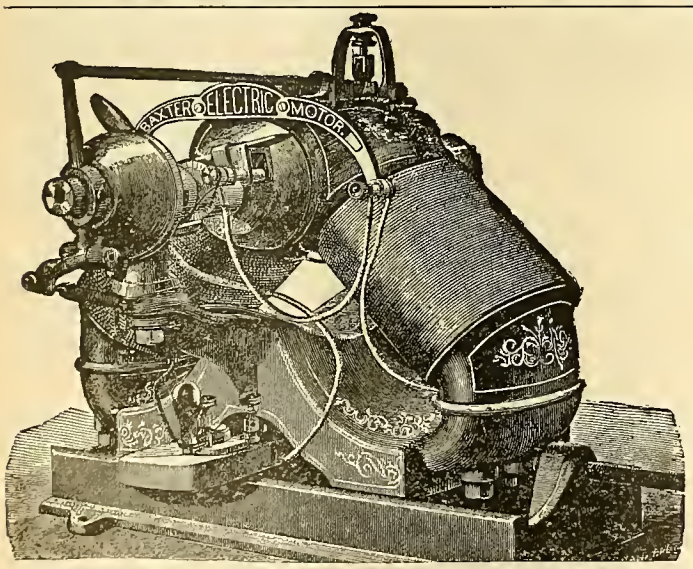

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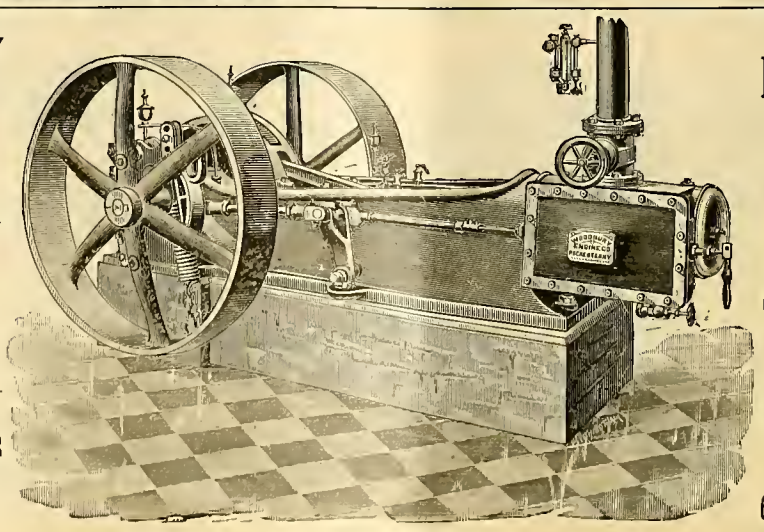

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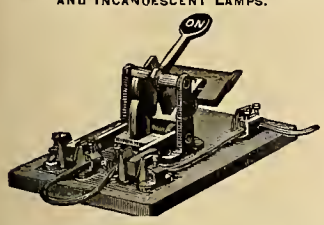

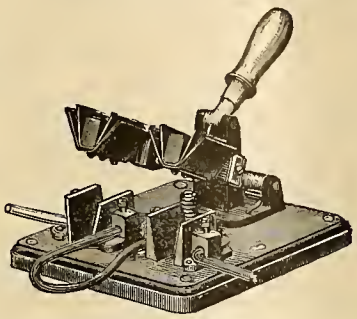

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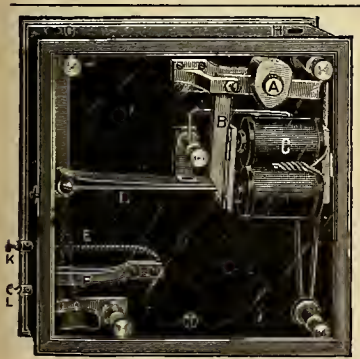

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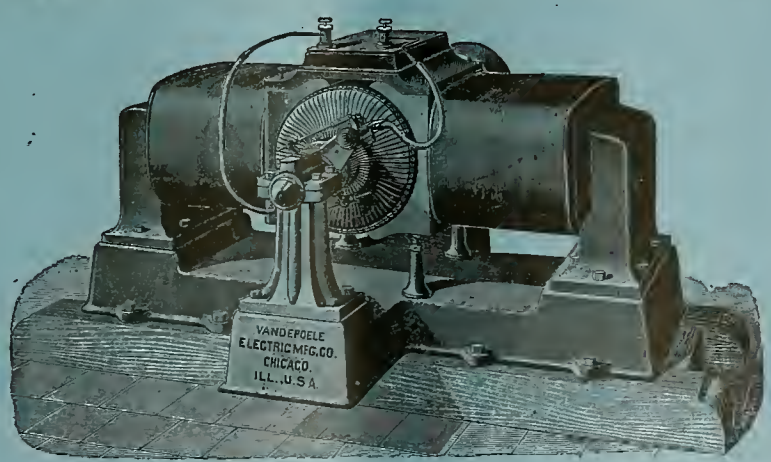

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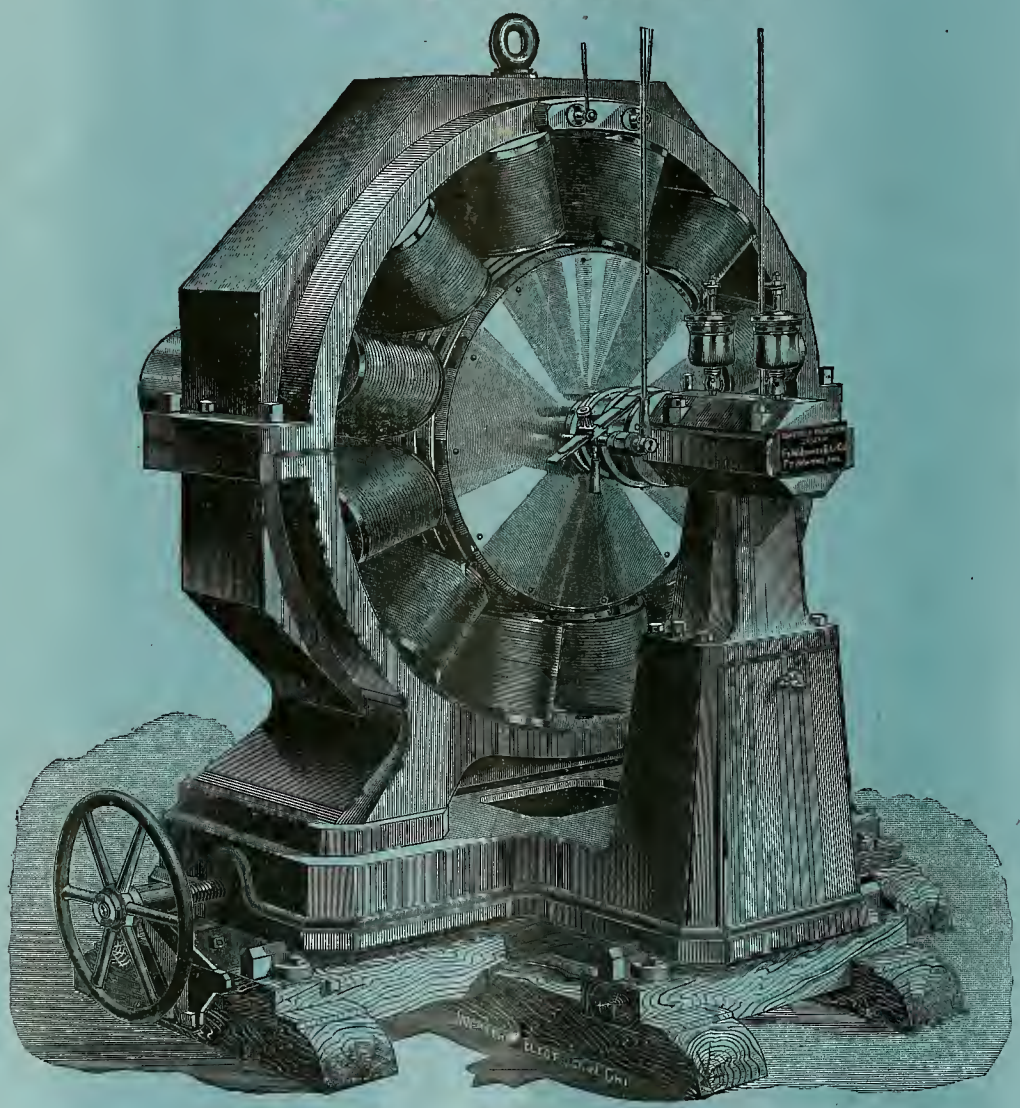

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LIGHT LEADED CABLES FOR HOUSE USE.

Weatherproof Line Wire, Underwriters', Annunciator and Office Wire,

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Electric Leather Belting.

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Wire Screwed, specially adapted for

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Every Belt Guaranteed.

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ELECTRIC DOOR OPENERS,

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APPARATUS OF EVERY DESCRIPTION.

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INSULATED WIRES AND CABLES.

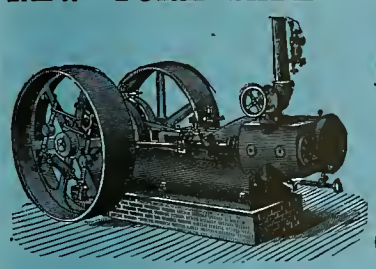
Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

TRINIDAD WIRES for Line Work in place of Underwriters.

ELECTRIC LIGHT WIRES of all sizes a SPECIALTY

NEW YORK SAFETY STEAM POWER CO.,

Builders of High Grade Self-Contained



Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

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And other duty requiring close regulation of speed.

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Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B, B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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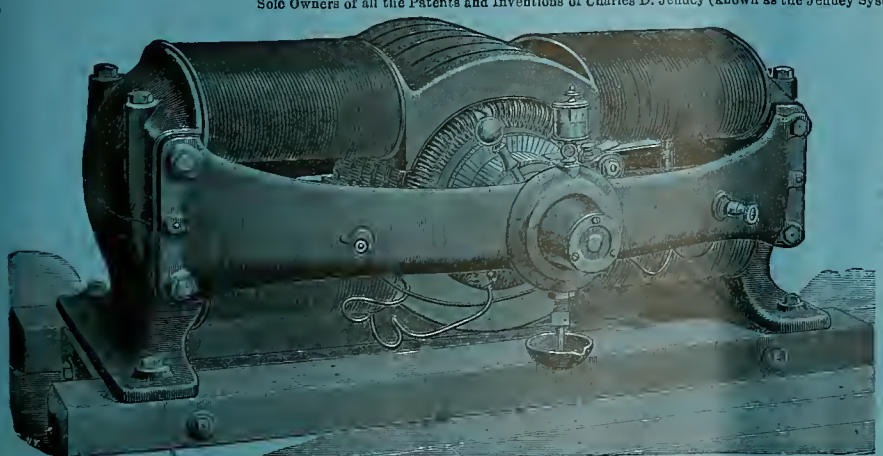
INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

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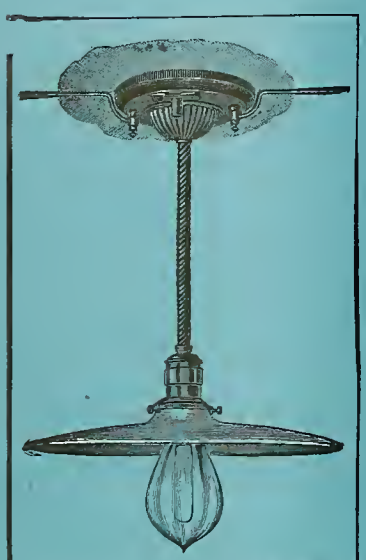
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



SERIES LAMPS

—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
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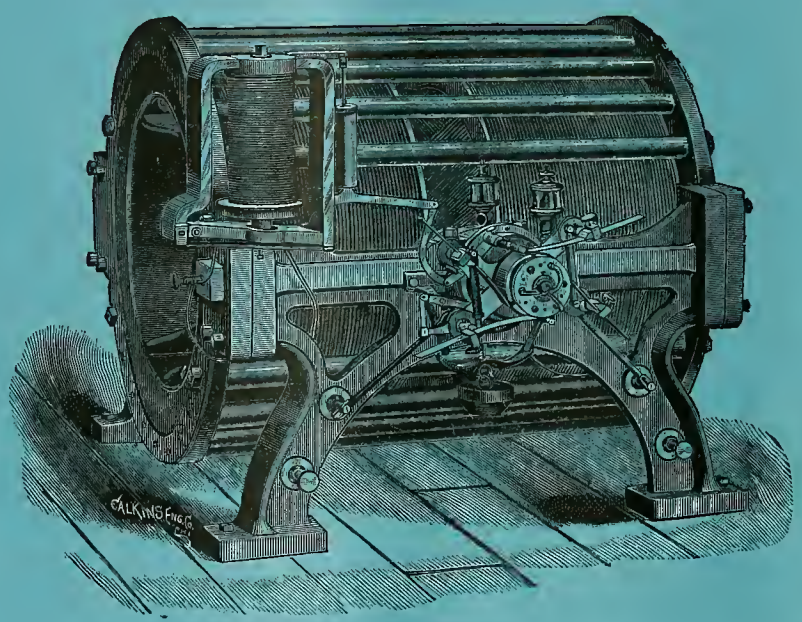
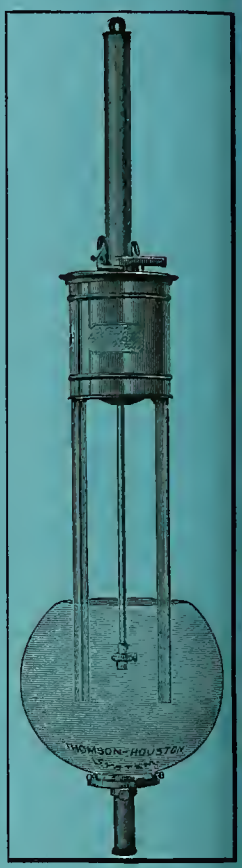


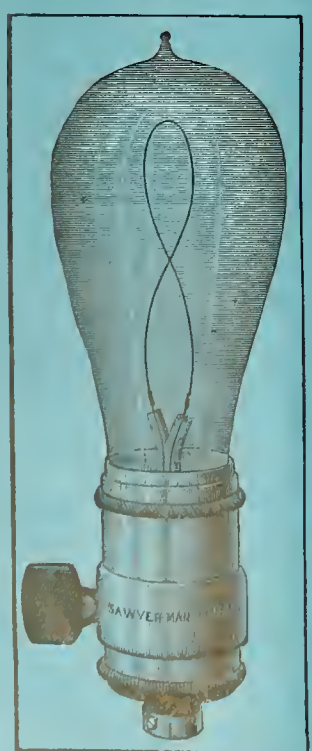


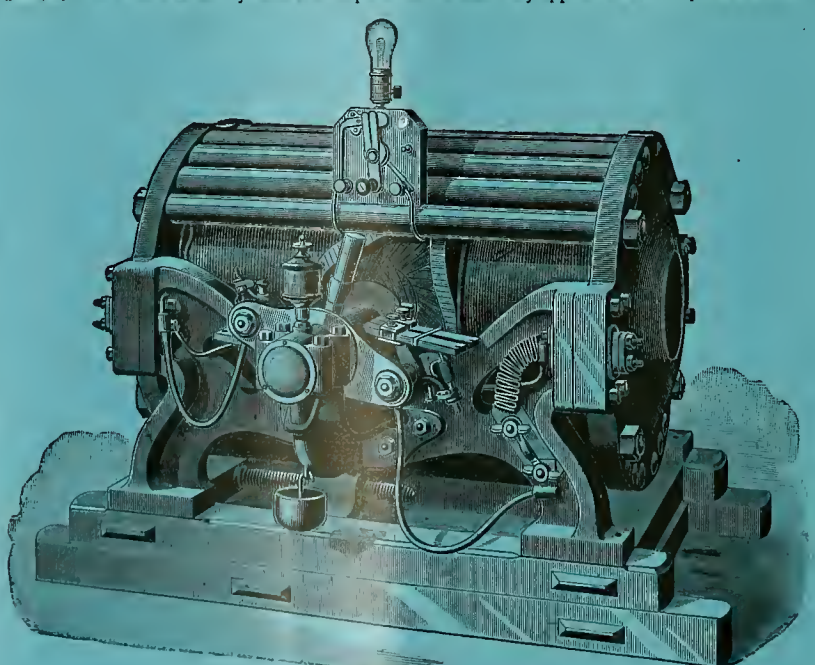
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

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OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the DYNAMO MACHINE (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,
16 & 18 BROAD STREET, NEW YORK.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{60}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

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54 and 56 FRANKLIN ST., CHICAGO,

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WE CARRY A FULL STOCK OF J. H. BUNNELL & CO.'S TELEGRAPH INSTRUMENTS.

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ELECTRICAL ACCUMULATORS or STORAGE BATTERIES,

Especially Adapted to

CENTRAL STATION LIGHTING,

Isolated Lighting, Railroad Car Lighting,

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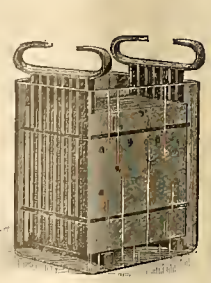

Among the Advantages of this System are:

Absolute Certainty of Light,
Increased Life of Lamps,
Great Economy of Running Expenses,
Absolute Steadiness of Current,
Utilization of Surplus Power,
Adaptability to Existing Plants,

And Complete Displacement of Gas.

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Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

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OWNERS OF THE SAWYER-MAN PATENTS.

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The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

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Roads in Operation or in Process of Construction July 14, 1888.

Richmond, Va	40 cars.	Davenport, Iowa	8 cars.
Richmond Extension	50 "	Salem, Mass	6 "
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Wilkesbarre, Pa	4 "	Hartford, Conn	2 "
St. Joseph, Mo	8 "	Scranton, Pa	20 "
Wilmington, Del	3 "	Steubenville, Ohio	6 "
Harrisburgh, Pa	6 "	Manchester, Va	10 "
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A Powerful and Rapid Cleaner and Polisher of Metals without Acid or Poison.
Especially Adapted to Railroad, Marine, Stationary and Fire Engine Work, "hot or cold;" Large Signs, Railings, etc.

This polish is now being supplied to Hundreds of Mechanical Engineers **ELECTRIC LIGHT PLANTS**, and manufacturers of Machinery. Has already been adopted by many of the leading railroad companies, the leading fire departments, water works, the U. S. Ordnance and Navy Departments, and thousands of Mills, Factories, etc. Is the BEST AND CHEAPEST POLISH IN THE WORLD, and quickest Cleaner. **Unequaled for Cleaning and Polishing Carbon Holders.** Send for Sample, FREE. Liberal discount to manufacturers and dealers in **Electrical Machinery.** Manufactured only by the

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NEW PATENT GAS ATTACHMENT

FOR FITTING ELECTRIC LIGHT SOCKETS TO GAS FIXTURES.

No more burnt wire conductors where this attachment is used.

Remove gas burner, screw nozzle in its place; by replacing and screwing gas burner on nozzle, you effect a solid, permanent, gas tight job. Send orders to **FRANK S. MARR, Contractor.**
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SOLE PROPRIETORS OF THE
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WE MAKE A SPECIALTY OF
BELLS, DISQUE LECLANCHE BATTERIES, GAS-LIGHTING APPARATUS
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SUPPLIES FOR ELECTRIC BELL WORK.

We publish Catalogues of all our Manufactures, and will forward to any address upon application.
N. B.—When applying for Catalogues, please state whether "Electric Bell" or "General Supply" Catalogue is wanted, and if in the trade inclose business card for discounts.

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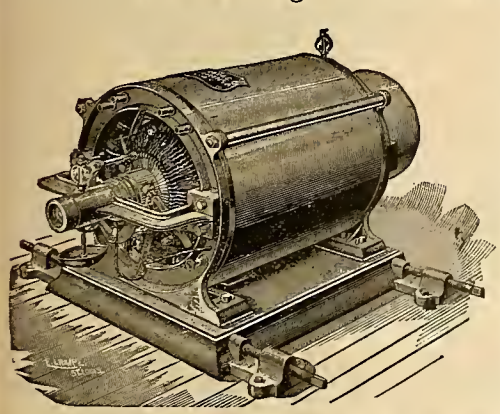
809-817 S. 7th Street, ST. LOUIS, MO.

MANUFACTURERS OF

The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single-Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

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In order to meet the constantly increasing demands for

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THE BISHOP GUTTA-PERCHA CO.

420-426 EAST 25th STREET, NEW YORK CITY,

HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

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FOR INSULATING WIRES FOR

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Also, special wires for Leading in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

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Use Marks' Compound Wire for Battery Coppers.

Use Balata Insulation for Flexible Cords.

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Agents in all Cities. Send for Trial Belt.

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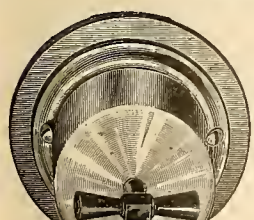
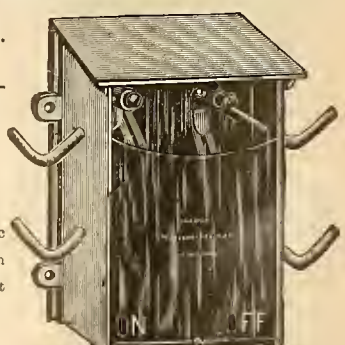
GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.





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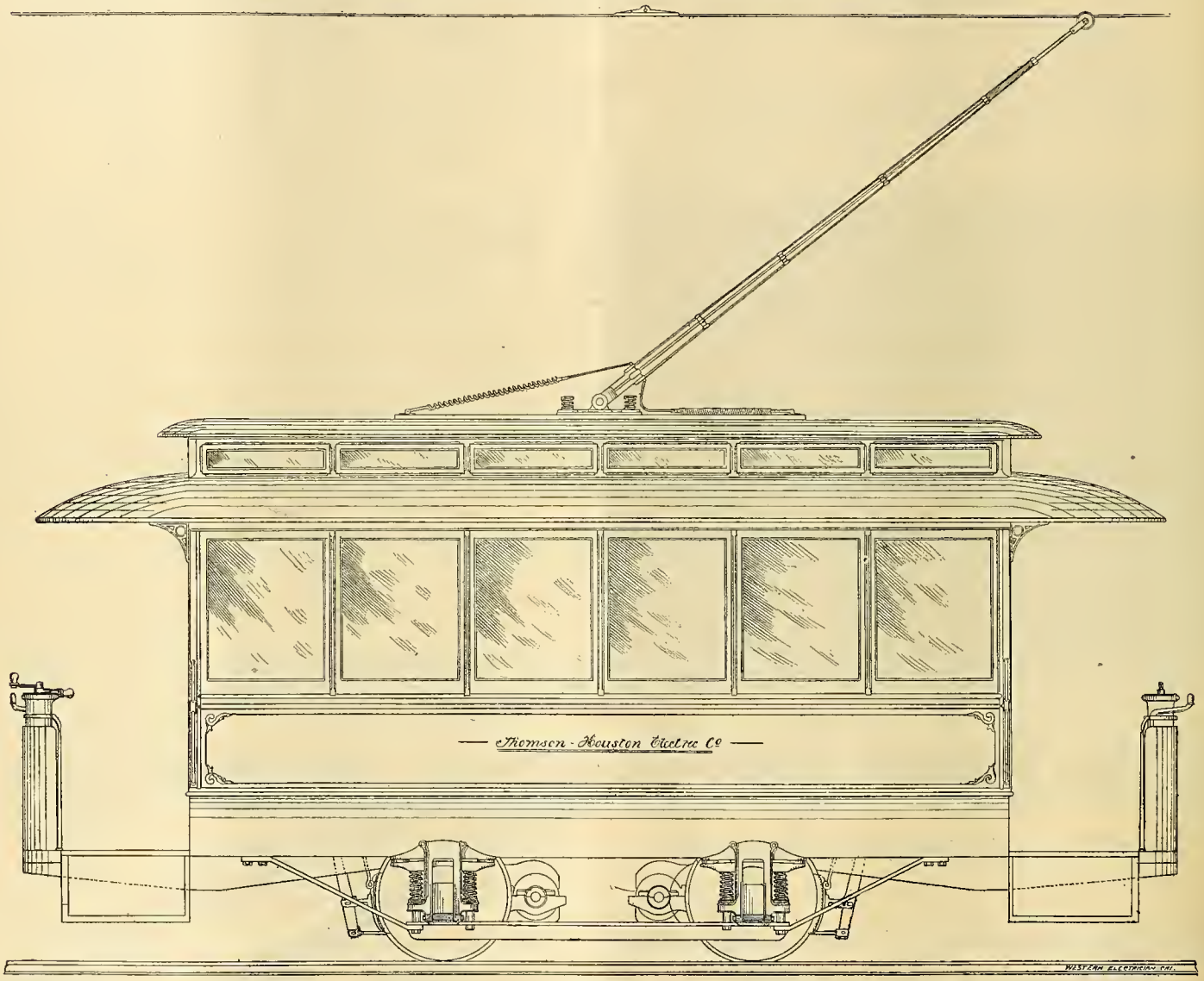
The Thomson-Houston Electric Railway System.

THE THOMSON-HOUSTON ELECTRIC COMPANY HAS RECENTLY PURCHASED ALL THE VAN DEPOELE ELECTRIC RAILWAY PATENTS.



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Only one pair of brushes for each motor.

Brushes self-feeding.

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Direct gearing is used.

The best and neatest overhead system is covered by the Van Depoele patents.

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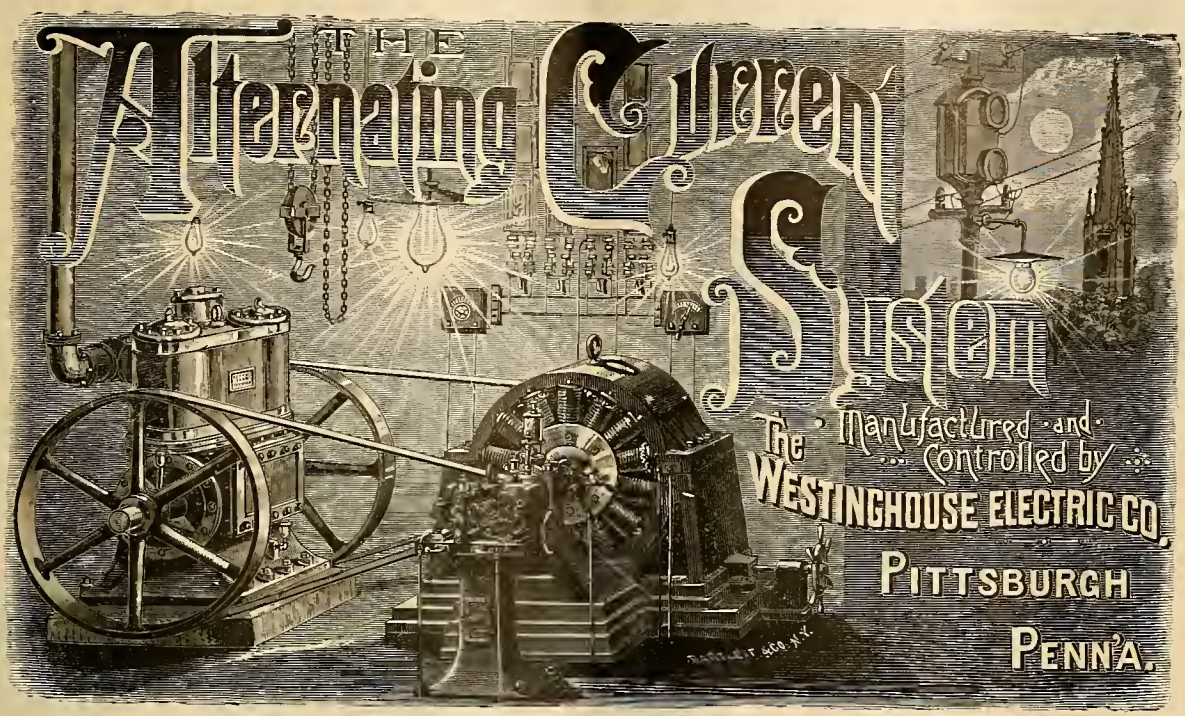

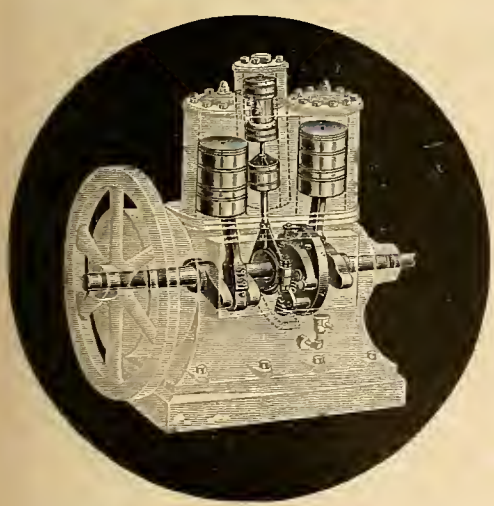

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Mark the second great advance in Steam Engineering, and represent the Highest type of

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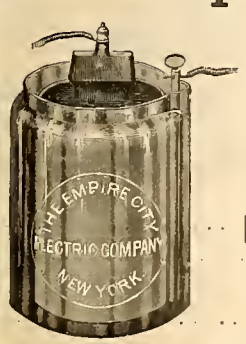

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United Electric Company.....Salt Lake City, Utah.
Western Engineering & Electrical Company.....Chetopa, Kan.
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S. F. Bartol.....Grand Windsor Hotel, Dallas, Texas.
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EVERY SATURDAY.

Vol. III. CHICAGO, JULY 28, 1888. No. 4.

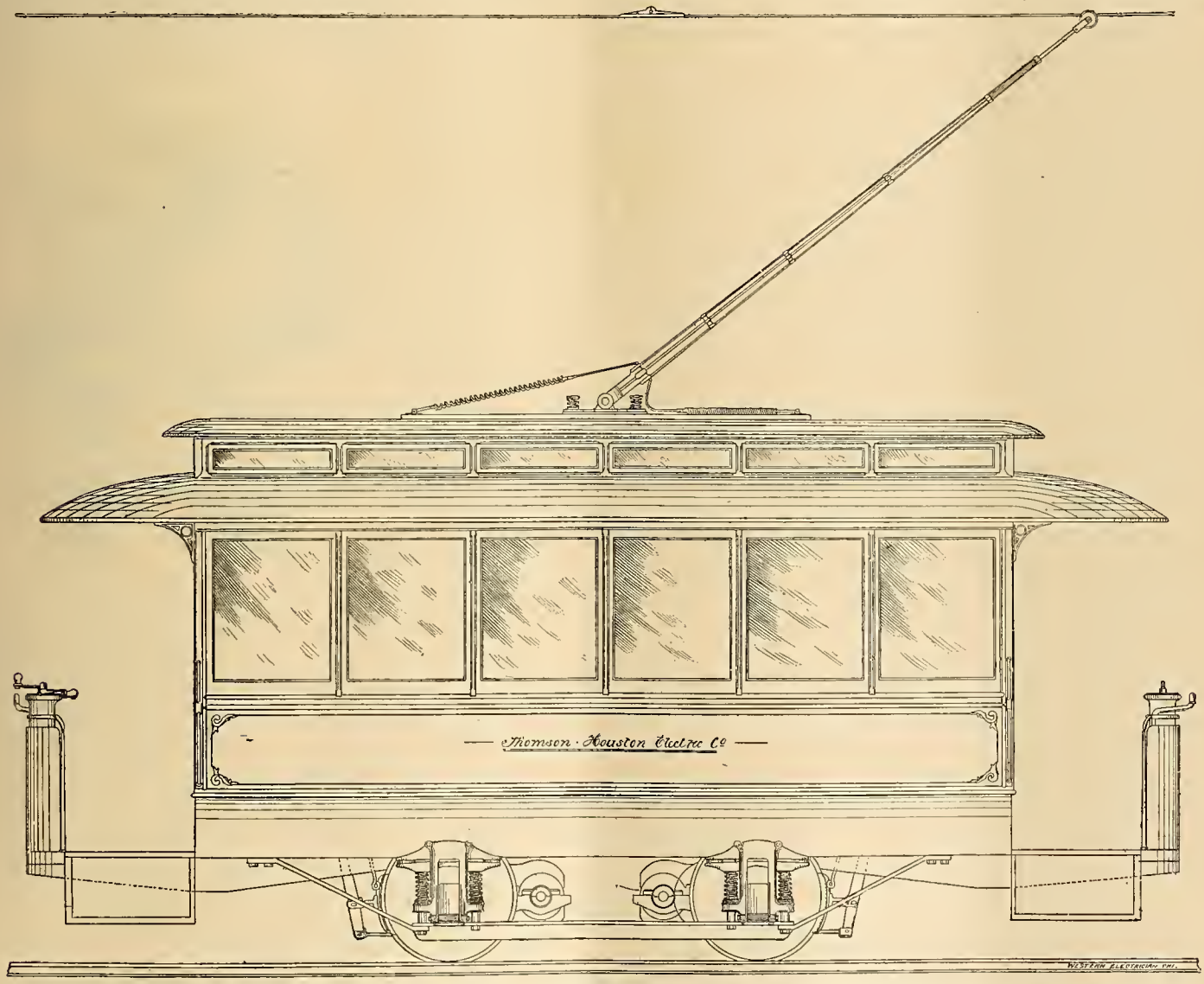
Thomson-Houston Electrical Railway System.

The accompanying illustration shows the general characteristics of the Thomson-Houston system of electrical railways. It will be noted that the motors are so placed beneath the car as not to project above the floor, or require the car body to be changed in any particular, or to be raised above its usual height. Only one pair of brushes is used with each motor, no change being required for change of load or direction of rotation of armature. The cars run in either direction with equal facility. Two motors are mounted on each truck, one attached to each axle, whenever the grades are so steep as to make such connection necessary; but, in general, only one motor is used, thus reducing the number of mechanical and electrical parts, the multiplicity of gears, the duplication of armatures and the increase in the number of wearing parts. In either case the motors are so mounted on the truck as to avoid any jar in starting the car, increasing the speed or reversing the motor.

The current is controlled, the car reversed and the brakes applied from either platform. The controlling device is simple, compact and efficient, and does not occupy space available for passengers.

A single wire overhead conductor is shown, the rails being used for the return current. This makes a light, unobstructive structure, hardly noticeable by the casual observer. Double conductors are used when required by special conditions; and, whenever necessary, the return circuit is reinforced by a continuous copper wire laid underground and connected with the rails. The main conductor is supported from bracket poles on narrow streets, where the tracks are on the side of the street; or on wide avenues where poles can be placed between the tracks. In other cases the conductor is supported by cross wires reaching from pole to pole on opposite sides of the street, or from building to building where the sidewalks are narrow and permission can be obtained from the property owners to place neat and strong fastenings on the face of the building. Poles are placed from one hundred to one hundred and twenty-five feet apart. The arrangement of the overhead line at curves and turnouts is one of the best features of the system. Light but strong metal supports are provided for the conductor, insulated from the poles and so arranged as to permit of easy adjustment to bring the conductor directly over the track. These supports are of such shape as to bring the conductor in the plane of the cross wires, so that the transverse strain of the latter has no tendency to tip the conductor supports out of the horizontal. The whole arrangement is light and simple, requiring but few extra cross wires.

On long lines or where the track is conveniently located, feeder wires are used to maintain a constant potential at all points of the line, and to prevent a break at one point from interfering with the operation of any of the cars. The possibility of such an accident is, however, exceedingly remote.



The standard method of obtaining contact is by the under-running trolley, consisting of a spring bar and wheel mounted on the top of the car pressing against the conductor from below, as shown in the cut. The under-running trolley is covered by the Van Depoele patents, and was first used by Mr. Van Depoele on the Toronto railway in 1885. The latest form avoids the projecting bar for spring attachment and provides for a constant pressure of the wheel against the conductor, whatever the height of the latter. It is light, neat and effective.

Bell Victorious over Cushman.

In the United States court in Chicago last Saturday, Judge Blodgett handed down his decision in the injunction suit of the American Bell Telephone company and others against the American Cushman Telephone company and others. On all points the court decided in favor of the plaintiff corporation. The decision commenced with a concise review of the voluminous evidence in the case. Judge Blodgett said:

"The questions presented are purely questions of fact. If Dr. Cushman did actually produce and put in use, to the full extent claimed by him, the apparatus constructed, as he describes his apparatus, so as to transmit articulate speech to a distance by means of an electric current, then, I should think, there would be no doubt that such fact should defeat the Bell patents, as the apparatus described by Cushman is conceded to be substantially identical in principle, construction, mode of operation, and result with the Bell devices. It is conceded that in order to defeat a patent by proof of prior knowledge and use of the device covered by the patent, such proof must be so clear and satisfactory as to leave no room for reasonable doubt.

"It is not my purpose to go into a complete analysis of the voluminous proofs in this case. It is sufficient to say that there is no proof in the records, save from Dr. Cushman himself, of the construction and use of the first apparatus described by him, through which he heard in the office at Racine the peeping of frogs in a swamp several miles away, and which, as he says, led up to the experiments which he, with the assistance of his brother, W. P. Cushman, and B. T. Blodgett, made the operative telephone of 1851. The evidence in this case is quite convincing that such an apparatus as he describes his lightning arrester to have been would not transmit the peeping of frogs or articulate speech, as the glass plate which he says covered the top would have entirely excluded the sounds from the magnets.

"Both W. P. Cushman and B. T. Blodgett, who, it is claimed, aided in the construction of the four talking-boxes in the summer of 1851, are dead, and the only witnesses aside from Dr. Cushman himself are the workmen said to have been employed in putting up the telegraph line from Racine westward. I think there is nothing shown by their testimony to have been accomplished by these experiments which could not be attributed to the action of a device operating as an acoustic telephone or the ordinary relay telegraph instrument then in use to transmit signals by clicks. That some kind of experiments were made in the presence of these witnesses is probably true, as I cannot believe that these men would intentionally swear falsely, but I do seriously doubt whether they witnessed at that time all the results to which they now testify. After these experiments upon the line we have the line from the back room of the Racine telegraph office, and from White's shop to Wright's carpenter shop, and the experiments there. That such a wire was run from one or both these places I cannot doubt, and I think it possible that some words may have been transmitted from one end to the other of this wire, but this result can easily be accounted for by the action of the device as a simple acoustic telephone, as the line ran direct from one point to the other and the distance was only about three hundred feet.

"The next alleged use is that of the wires between Dr. Cushman's house in Racine and the farm of W. P. Cushman, six miles away. The proof as to this use rests upon the evidence of Dr. Cushman alone, and I do not think the attempted corroboration of his testimony by Josiah B. Cushman's testimony is reliable. The practical use of these talking boxes, in 1854 and 1855, does not show results which may not have been obtained by the acoustic telephone.

"My conclusion from a careful reading and consideration of this mass of testimony is that Dr. Cushman, with the aid of W. P. Cushman and B. T. Blodgett, in Racine, during the summer of 1851, did make a device containing magnetic coils through which spoken words could be and were transmitted at short distances; that the transmission was faint and the words difficult to hear, and the attempt to talk through them was often a total failure, and occasionally when all conditions were favorable only a partial or meager success was obtained. . . . . I have no doubt from the proof that the machines made by Dr. Cushman, W. P. Cushman, and B. T. Blodgett in 1851 were in all practical respects as good as any that were made afterward by Dr. Cushman or those who assisted him. Orrin White tried to improve them, and afterward Joshua B. Cushman made an effort in the same direction, but they were so imperfect in their operation as to offer no promise to any one of their future possibilities. These considerations compel me to the conclusion that all the testimony, when taken together, falls short of establishing beyond reasonable doubt the fact that Dr. Cushman in 1851 invented the telephone, and what was done by him must and should be treated as at best only an abandoned experiment.

"I do not think the testimony when fairly considered shows that Dr. Cushman produced at Racine or elsewhere prior to the invention of Bell a practical, operative telephone of any kind. He gave the world nothing—what he did, if he did anything but make an acoustic telephone—was suffered to die in embryo or germ, before any valuable or useful fruition. I do not believe the machines made by him during these experimental years were so far perfected as to be of any practical value, or to even suggest that they might be so improved as to become valuable and useful. If a word could be occasionally transmitted through them the result seems only to have excited curious wonder in the south, and did not challenge the attention of practical men, as did the first exhibitions of the Bell device. When the Bell telephone was brought to the attention of the public its value and utilities were grasped at once. It was accepted as a great invention by the general public as soon as its operation was seen, and I can see no reason why the public would not as readily have comprehended its advantages and value in 1851 as in 1876 had the machine been so far developed as to give substantial promise of what Bell accomplished."

There were many inconsistencies and contradictions in the testimony of the Cushmans. Their statements were in many points wholly unreliable. The court did not intend to intimate that they had committed perjury. But their whole subsequent experience with the telephone had quickened their imagination, and led them to believe that their instrument contained principles which it did not possess. Cushman's invention dated in 1851, and Bell's in 1876, and when the former saw the great value of the latter instrument, there was no doubt that he was deeply moved to think that he had so narrowly missed so great a prize. But if Cushman really had an instrument over which he could talk for a distance of six or seven miles, he would have patented it. Racine at that time was a city of four or five thousand people, with one or more newspapers. While these newspapers gave long descriptions of Dr. Cushman's other inventions, not a line or paragraph was printed about the telephone, which, if it existed, was the most wonderful of them all. When the Bell telephone was invented, all people at once realized its useful and practical character, but no one seems to have thought that there was anything useful or practical about the Cushman invention.

The court concluded that the testimony when taken together failed to convince it that Dr. Cushman in 1851 invented the telephone. Whatever was done by Dr. Cushman should be considered an experiment. He did not believe that the machine made by him was perfected so as to be of any practical value. A word might be occasionally transmitted over it, but it was only an object of curiosity.

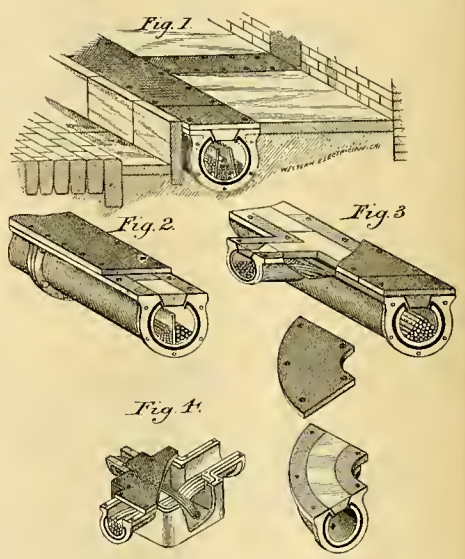
Judge Blodgett entered an interlocutory decree declaring the Bell patents valid and the exclusive property of the complainant company. The defendants were declared to have infringed upon these patents, and it was ordered that the complainants should recover of the defendants the profits made by them by reason of their infringement and damages sustained by such infringement. A reference to Master in Chancery E. B. Sherman was ordered to ascertain and report the amount of damages. Finally, the court granted a perpetual injunction against the defendants restraining them from any further infringement of the complainants' patents, and ordered them to pay the costs of the suit.

Dr. Cushman, when asked what he thought of the opinion, said:

"It's not in accordance with the facts of the case, and we will not stand it. We will take an appeal to the fall term of the Supreme court of the United States. There are several inconsistencies in Judge Blodgett's decision. The judge admitted that conversations had been held over the Cushman telephone, and yet he insisted that it was merely a toy—a curiosity—and held that the plea for the injunction was good because the invention had not been properly developed."

Irish's Conduit for Electric Wires.

A new form of conduit devised by W. E Irish of Cleveland is shown in the accompanying cuts. It will be seen by referring to Fig. 1, that the wires for all electrical purposes are carried in the same conduit; that they are at all times easy of access from the surface of the roadbed and at any point throughout their length they may be tapped or dealt with as desired. The wear and tear due to drawing in may be avoided in this system, and additional wires put into the conduit at a minimum expense of time and money. It will be further seen that although the wires for different purposes are placed in the same conduit, each class is grouped in a separate duct from the rest. In Fig. 1, the duct on the left of the conduit is represented as containing only arc wires, which are laid in rows in the hollows



IRISH S CONDUIT FOR ELECTRIC WIRES.

of corrugated sheets of asbestos packing which not only increases their insulation but forms a packing which is impenetrable to moisture. Incandescent wires are represented as being in the next duct without packing. The third duct is represented as containing telephone wires. The latter are shown as having corrugated sheets of thin varnished iron placed between each layer of the wires so as almost to surround each wire with a sheathing of iron to prevent inductive influences. It may not always be necessary to treat the incandescent and telephone wires as the arc and telephone wires are treated for reasons well understood, but the small additional cost should not prevent their being protected in like manner.

The conduit consists of a tubular pipe cast in sections with flanges which are recessed on the inside to receive a rubber ring which forms a gasket or packing between two sections when bolted together. The conduit is provided with a longitudinal slot or opening along the top having inwardly inclined sides and flat surfaces on either side of the slot to which the cover is secured by screws. In order to prevent the entrance of water or moisture to the conduit through this slot a strip of rubber or leather is first laid on top of the flanges extending from one outer edge to the other. On this elastic packing a solid wedge shaped piece which fits the slot snugly is placed so that when the cover is screwed down the wedge with the packing surrounding it is forced into the slot so as to seal it perfectly. Wires of any desired length

may be laid in this conduit without the necessity of making a single joint. Additional wires may be added to a conduit already partly filled without interfering with the wires already there. Any wire can be tapped at any point by simply removing the cover and making the necessary conections at that point.

Fig. 1 represents the conduit laid beside the curb of a walk.

Fig. 3 is a section of a conduit with a branch conduit to carry off a portion of the wires.

A junction box is represented by Fig. 4.

Fig. 7 is a view of a street corner showing lamp posts and conduits crossing various thoroughfares.

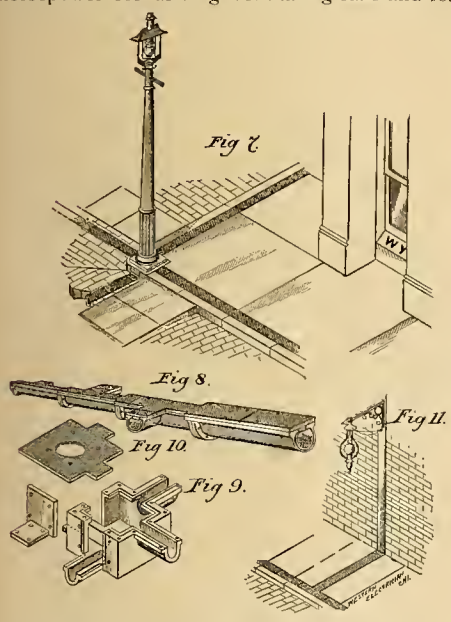
Fig. 8 represents several sections connected and diminishing in size as the wires are carried off by the several side or branch conduits.

Fig. 9 is a view of junction box where the crossing is on different levels.

Fig. 11 shows an overhanging lamp supported on bracket, and connected by a short conduit to the main.

Auditorium Electric Plant.

Considerable interest has been taken by electric light companies in the award of the contract for lighting the Auditorium building, Chicago. To illuminate the immense building 8,600 lights will be necessary. In addition motors are to be supplied for furnishing 200 horsepower for driving ventilating fans and for



IRISH'S CONDUIT FOR ELECTRIC WIRES.

operating kitchen and laundry machinery of various kinds. The building is divided into two sections. For the section in which the auditorium and business part are located, 5,000 lights are to be used. Motors of capacity aggregating 65 horsepower will be employed. This plant will be subdivided into a plant for the auditorium and one for the business part. The hotel will contain 3,600 lights, and will be provided with motors capable of developing 135 horsepower.

The dynamos for the main part of the building will be six in number; four of 1,200 lights capacity each, and two of a smaller size. For the hotel three dynamos of 1,200 lights capacity each and one smaller machine will furnish the current. The lamps are to be of 16 candlepower.

In the auditorium and in the public parts of the hotel no fixtures will be used, but the lamps will form essential parts of the wall and ceiling decorations. In the auditorium will be a large ceiling light of colored glass about 20 by 95 feet. Above it will be about 108 lamps. A similar disposition will be made of lamps in the small concert hall at the west end of the auditorium. On the auditorium stage will be 1,100 lamps.

The following companies sent in bids for the work: Leonard & Izard, representing the Edison; United States, Thomson-Houston, Brush, Mather, Westinghouse and Electro-Dynamic. In considering the bids, the executive committee followed this course: To the estimates of the bidders, 6 per cent. was added for interest, and 6 per cent. for wear and tear, and to this amount were added the guaranteed estimates of cost of fuel, water and lamp renewals. Figures for salaries were omitted, as they would be substantially the same for all systems. The figuring was close. Between the figures of Leonard & Izard and the United States company which were, it is understood, the lowest bidders, there was a difference of only $150. Between the figures of the highest and lowest bidders there was a difference of $2,000. The committee decided to award the contract to Leonard & Izard. It is understood that their bid was about $50,000.

It was rumored, and the rumor was found to be correct, that the committee decided at first to divide the award, giving one section of the building to the United States company and the other to Leonard & Izard. This report was confirmed at the office of the United States company, where it was stated: "The award was made to the two concerns, but the United States company decided not to accept the contract."

The condition on which the contract is awarded is on a guarantee of 12 16 candle-power lamps to the horsepower, and of 1,000 hours' life for the lamps.

The contract for the engines has not yet been decided upon definitely.

Heat from Electricity.

On a small street in this city lives an inventive mechanic who for years has spent his spare time in a little shop back of his house, says the Cleveland *Press*. In it electricity reigns supreme, and the owner has worked out the triumph of many hours of study. Models of almost every electrical apparatus known he has made for himself. In front hangs a powerful carbon light, while every corner is illuminated with soft, mellow incandescent bulbs, all made by himself and run by his own dynamos and engine. Miniature buzz saws running so fast as to be almost invisible, electrical cars, phonographs, telephones, batteries, and motors of all kinds, everything operated by electricity, turn this curiosity shop into a place where one feels the very influence of that subtle fluid on his body, and even in his brain.

All these machines and toys are mere byplay to the great discovery of generating heat from electricity, on which he has been spending his lifetime. Under a cloth stood his invention, small, yet perfect and capable of generating enough heat to turn the shop room into a regular Turkish bath. The inventor uncovered the machine and explained some of its workings, but the most important parts are still secret. "For years," he said, "I studied and experimented in vain. My first work was on the rule that from the result the cause could be produced. Following this theory I commenced on the electro-thermic battery, reasoning that if heat generated the electricity, by working backward heat could be made by electricity. For a long time I clung to this, but had finally to abandon it as practically impossible.

"Some of my experiments produced heat, but not in sufficient quantities to be of any benefit. Finally I started off on another tack, and began a new line of reasoning. Heat is simply an accelerated motion to the molecules of a body which crowd out a larger space for themselves in their faster movements, and consequently cause the expansion noticed in a heated object. The heat is diffused by radiation, that is by imparting its motion to the adjoining molecules. This is the case either in a solid body or in fluid. Following up this theory I began experimenting with electricity as a means for causing an increased motion to the molecules of a body. The first thing necessary was to form a substance on which the electricity could act. Here it is."

An irregular shaped piece of composition that looked like a lump of coke or carbon was disclosed to view. Wires were connected at opposite ends of it, and that was all. The inventor pressed a button, and in an instant the mass gave forth a heat, not dry like a furnace, nor yet damp, but that pleasant warmth felt on a spring day when the sun shines brightly and fairly invigorates a person after the cold days of winter. In the further corners of the room the heat evenly penetrated, and except when quite close the sound could not be noticed. The mass did not change color or present any different appearance when the current was shut off.

"The composition of that is the first secret," said the electrician as he broke the current, "and will be so as long as I can keep it. As you can see, it is principally carbon to conduct the electricity. By adding certain acids it can be melted and moulded in any form desirable; in masses to put in grates, shaped like radiators, flat and placed under registers or whatever way wanted. I call it by a new name, carbodium. But here is the most important part of the whole thing; the machinery which gives motion to the molecules and generates heat in the carbodium. It consists of a device for making and breaking a strong current of electricity as is done in an electric door bell. This, however, is made on an entirely different plan, and cost me two years of study. The current is intended to pass through this and in jerks to the carbodium. On that peculiar composition it has the effect first of producing the small amount of heat given off by an electric light or two wires when crossed. This is sufficient to start the accelerated action of the molecules, which is then taken up by the electricity, coming in broken currents faster than the motion of the molecules themselves, and quickly causes an intense heat."

Phonograph and Graphophone Controlled by One Company.

The phonograph and graphophone patents have been secured by one company, and by next fall both instruments will be put on the market. It has been undersood that for several months negotiations have been pending between the Edison Phonograph company, and the Graphophone company to adjust differences so that litigation would not follow the claims of each corporation of infringement of patent. The result was announced last week. Those interested in the Graphophone company have purchased all the rights of the Phonograph company. Mr. Edison is to be paid a certain sum annually, and in return the new company which is to be known as the North American Phonograph company, is to be entitled to all improvements on the instruments hereafter made by him.

The company will model its business after methods of the Bell Telephone company. Companies will be licensed by the parent company to transact business in graphophones and phonographs in different parts of the country. The instruments will be rented, not sold, and the rental will be $40 per year in all parts of the country. The instruments will be kept in repair and will be provided with improvements as rapidly as they are made. A company is to be formed in Chicago, which will probably be known as the Illinois Phonograph company. Subscribers of the company will be allowed to choose either the Edison phonograph or the Taintor graphophone.

These facts were obtained from Thomas H. Lombard, vice-president of the new company. He came to Chicago last week and exhibited the instruments to hundreds of interested persons, who had received invitations to call at his rooms at the Palmer House. The two graphophones which were on exhibition are identical with that recently described in the WESTERN ELECTRICIAN. One of the instruments is operated by a motor; the other by an ordinary treadle.

A matter of much interest in connection with the phonograph now is whether or not a tariff will be charged on the cylinders. It is asserted that songs can be brought over in the cylinders, speeches of great men can be brought here, and much other material of great value can be thus conveyed into the country. The question to determine is: Is not such a cylinder a manufactured article, and is it not subject to tariff laws?

Great preparations are being made at the Brooklyn navy yard for the laying of the keel of the armored cruiser Maine, which when completed will be the largest man-of-war ever built at any of our navy yards and the largest iron ship of the modern type that ever went to sea floating the stars and stripes. The electric plant will consist of four sets of dynamos and engines so connected that any one can supply all of the circuits for the incandescent lamps. There are three arc lights to be mounted, any of which can be connected with any dynamo.

The Solution of Municipal Rapid Transit.[1]

By Frank J. Sprague.

PART II.

For the immediate solution of the question of more rapid and cheaper transit in many places the overhead system is most available.

I am aware that a great hue and cry has been raised, especially of late, against any electric wires whatsoever being used above ground. The feeling which exists is not entirely unreasonable; in fact it is easily accounted for by the most casual inspection of the condition of the wires of this city. But many of the objections which are raised against all overhead systems are not necessarily inherent; they are very largely due to gross carelessness in construction engendered by a faulty municipal administration. We have in our cities little or no active control or oversight of the wires which have been put up in our streets. Year after year, from the earliest telegraph days, those in control have granted to telegraph, electric light, telephone and electric power companies innumerable more or less limited franchises for stringing or hanging wires through our streets. These permits have often been granted without any restriction whatever; they are often granted for a "consideration." The erection and maintenance of these lines being a large factor in the cost of construction and operation of the companies, they have been put up with little or no regard to public convenience or safety—certainly with no regard to any æsthetic tastes—and oftentimes with an utter ignorance of the proper methods of construction. Fire underwriters, in their wisdom, have demanded an insulation to stand fire, forgetting, or in apparent ignorance of, the fact that protection from moisture and leakage is of far more vital importance. Hence we have that treacherous wire known as "underwriters' wire," or more commonly among electricians, "undertakers' wire."

The poles have, until lately, been of the cheapest construction, badly set and continually marred and weakened by the spurs of the lineman. New lines have been continually added, and poles intended originally for a certain number of wires are now carrying double or treble that number.

The electric light companies, after cutting out a lamp for which a contract has expired, leave the bights of their wires hanging in loops. The telegraph and telephone companies allow thousands of miles of "dead" wires to remain overhead, or to hang in festoons from every pole, which in some sections are utilized as clothes lines or are used by the street urchins as kite traps.

They cross and recross the streets at every angle, every elevation, and at every tension. They are strung surreptitiously on poles to which no right exists and over buildings for which no permit has been granted.

No one seems to have the power to compel a change or improvement in these practices, and the companies themselves will never do it until so compelled. The sharp competition in the lighting business, the small profits derived therefrom, the great trouble of hauling down and getting rid of miles of dead telephone and telegraph wires, all these interfere with a satisfactory straightening out of the existing system of overhead wires.

In all improvements for public improvement we have to consider the arguments for as well as against such improvements. It is not sufficient that we say that there are disadvantages attending the introduction of the system, we must consider likewise the possible advantages; and this is especially important when we consider the use of the overhead line in a system for propelling street cars. Such a line being part of an investment of a company which has practically no competition on its own streets, and whose own interest would require it to keep its line in first-class condition, can be put up in a manner presenting few of the objections which are generally urged against a system of overhead wires. I would not urge its adoption for all places, but in all suburban districts, for comparatively narrow streets, for all streets operating under an elevated railway structure, or where the tracks are near a sidewalk, the direct system of supply from an overhead line with underneath contact, presents advantages which, once appreciated, far outweigh the possible objection of such a system.

Several methods exist in which the wires can be erected. One in which span wires, at a distance of 125 feet apart, reach across the street from building to building, or from pole to pole, and has suspended from it, directly over the track, at a height of about 19 feet, a longitudinal wire of not more than a quarter of an inch diameter, this wire being termed the "working conductor." This should be of the very strongest character. It should have a high elastic limit, great tenacity, and resist corrosion and oxidization.

Its conductivity is a matter of less importance, since not upon it, but upon the main conductor which supplies it do we depend for the main transmission of our current. Hence the elements of strength and reliability are of far more importance than conductivity. We have found that the best wire for this purpose is that alloy known as "silicon bronze"—a wire which can be drawn for a tensile strength of from 75,000 to 150,000 pounds per square inch; that is a strength higher than that of the best commercial steel. Such a wire it is almost impossible under conditions of service to break, and its life is very long. Samples of hard drawn copper wire, which possesses only from one-third to one-fifth the tensile strength of this wire, show, after months of severest usage, scarcely any signs whatsoever of abrasion, or reduction in size. This wire is of the same size whatever the distance run or the number of cars operated, and the main conductor may be stretched along the buildings, through a side alley, along poles, underneath the elevated structure, or buried underground.

In the latter case there would be in a single track street only one longitudinal wire, and that one over the track, and it would be no larger than a single telegraph wire; and in the case of a double track, there would be only two wires stretched longitudinally along the street, and these would be as taut as harp strings.

Switches and cut-outs are put in main, and working conductors in such a way that the different sections can be operated independently, and cut out automatically, or at will.

The span wires can be as much above 19 feet from the ground as is desired. Of course, where a telephone or electric light line crosses the street and may break and fall upon such a conductor, it would be necessary to have one or two guard wires above it.

These guard wires can be very properly carried from the span wires themselves. Furthermore, if desired, the stretches between the span wires where the guard wires are used can be very much longer than 125 feet; they can be even as long as 500 or 600 feet—that is, two or three city blocks—in which case the two guard wires form a light, suspending structure from which, at intervals of a hundred feet, the middle wire is carried in a straight line.

In very many cases it is unnecessary to have any span wires whatsoever. In those streets where the track runs near the curb a light pole with an ornamental bracket is all that is necessary.

In a broad street where the tracks occupy only a small portion of the street, and are near together, a line of poles of ornate design with light arms projecting on either side, can follow the center of the street. Oftentimes there is a middle division or park, such as exists on the Boulevard in this city, which will afford space for the poles without interfering with anything.

These same poles can be used for lighting the street.

On streets occupied by elevated railroad structures, the structure itself can be used as a support for the overhead wires.

Among the numerous places in New York where an overhead system could be put in perfect operation are Eighth avenue, from Fifty-ninth street up; the Boulevard, from Fifty-ninth street up; a part of the First and Second avenue lines; the Third, Sixth and Ninth avenue lines, and all the suburban extensions in the annexed district.

To avoid any extra strain on this wire, the current is taken off by a flexibly supported trolley carried on the car, and making contact underneath by upward pressure as will be more specifically described later.

With such a system put up in the proper manner, it is almost impossible for any accident to occur which will disable the line or prove a hindrance or annoyance to the public in any way.

The wires are perfectly clear of the operations of the firemen, and should they in any place interfere the obstructing section can easily be cut out without disabling the remainder of the system.

The question of "electromotive force," or electrical pressure, so to speak, to be used, is one of great importance. I do not favor going above 400 volts, and this on a continuous current circuit. This is less than one-seventh the electromotive force which exists on many of the arc light circuits in this city; and the current being of a perfectly smooth and continuous character is free from the danger which might be feared from a current of equal electromotive force of the alternating or pulsating character.

In point of fact, in Richmond, a very large number of our men have received the full e. m. f. from our line without any injury.

On a dry day, the trolley wire has lain coiled up on the ground while the cars are in operation; and while certain changes were being made in the overhead circuit, the men work continually with the current on the line. I have never known a constant potential current of 400 volts to cause of itself the death of or serious injury to a human being.

The past year to me has been one of great responsibility and wide experience. It has been a hard year. But the experience and expense are as nothing compared with the great value of having been with my associates instrumental in bringing to a successful issue one of the most important pieces of electrical engineering with which I have ever had anything to do. Among the roads which we have equipped the most important is, of course, the Richmond Union Passenger railway, which now has six times as many machines in operation as any other road of its character in existence, at which every difficulty to be encountered in an overhead system on heavy grades and with sharp curves has been made, and which has for all time conclusively settled the question of the economical operation of a large road by the method of direct supply.

I will briefly refer to the road, giving some illustrations of its principal features, and some facts about its operation.

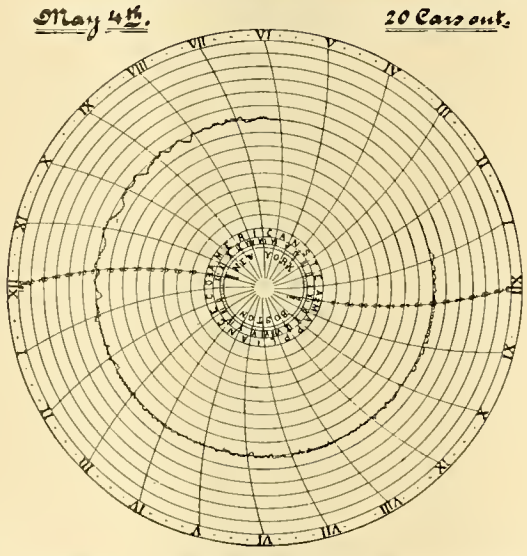
Some idea of the character of the road may be gathered from the following: The total trackage is about twelve miles. It runs a very irregular course and reaches the principal parts of the city. About nine miles of street are covered. The central section is a double track for a distance of something over two miles, a part being laid on paved streets, and the balance on macadam or unpaved streets; all the extension and branch lines are on unpaved streets, many of them in clay soil, which in wet weather covers the tracks, and where it would be an impossibility to operate horses without paving. The double track section partly encircles the old State Capitol, and presents difficulties rarely equaled elsewhere. This part of the line in a distance of less than one thousand feet has on both east and west-bound tracks, four curves, the inner rails of the west-bound track being of about 27, 30, 40 and 30 foot radius. The power necessary to run these sharp curves is much increased by the fact that grades are encountered on the curves as high as eight per cent., and the lay of the street has required some of the outer rails to be some inches below the inner one. Running eastward from the capitol the road descends to a low valley through a series of grades varying from three to ten per cent., and then ascends a series of sharp grades and curves in a new district to one of the car houses.

Going west from the State House the road rises to nearly the highest point in the city, and then runs through a residential district across the Richmond, Fredericksburg & Potomac railroad, and after several sharp curves extends back a further distance of two miles to a second car house beyond the new reservoir. Two branches connect with its main line, one leaving at the old Market Place crossing, and paralleling the Chesapeake & Ohio railroad, and terminating at its machine shops. The other runs into what is popularly known as "Africa," a section almost exclusively inhabited by colored population.

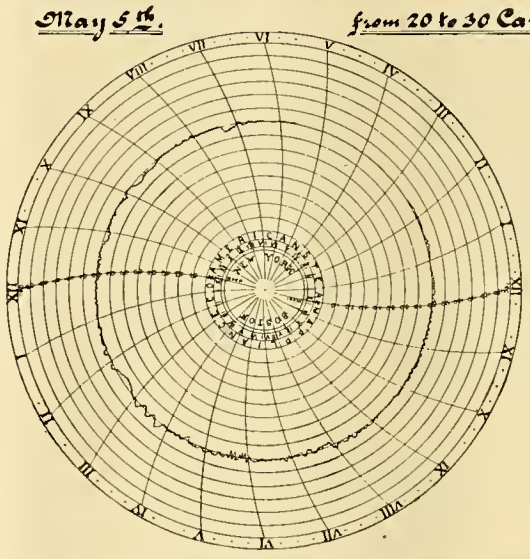
The narrow streets, their hilly character, and the lack of paving, especially in the new districts, has made the road

Steam Diagrams of the Richmond Union Passenger Railway Co.

May 4th. 20 Cars out.



May 5th. from 20 to 30 Cars out.



[1] Read before the American Institute of Electrical Engineers, June 14, 1888.

one of exceptional difficulty to operate. There are no less than twenty-nine curves requiring bent rails, the majority being of sharp radius, five being less than thirty feet. There are also several sweeps or curves of large radius, several turnouts and cross-overs. The grades are the maximum ever ascended in practice by a self-propelled car depending on track adhesion alone, and many of these grades are very long. Going east there is one section of almost continual ascent for about 5,600 feet, with grades varying from three to seven per cent., and going west there is a stretch of 1,900 feet, with grade varying from three to ten per cent.

When we first undertook to equip this road in the face of these difficulties, there was the additional discouragement of the ridicule of a great many prominent street railway men and car constructors as well as electricians. It was only a comparatively short time ago that one of the leading lights in the street railway circles made a report to the street railway convention in which he stated that unless some new invention should be made it would be impossible for any self-propelled vehicle to satisfactorily operate under the ordinary condition of street-car service. He, as others, held that the grades and curves met in practice were so severe and the condition of the track so bad that a car propelled by its own wheels could not under any possibility, day in and day out, be relied upon to move itself. One electrician even made the statement only a short time ago that any man who should attempt to operate on more than a six per cent. grade would lose his reputation.

Reliability, economy, simplicity of construction and operation on a scale never before attempted and under conditions which we could not foresee. This was the problem, and perhaps it was well we did not know the difficulties. Then again, while there have been strong friends of the enterprise in Richmond itself, there was a class that felt anything but pleasure at the stranger's advent.

The change of feeling with which this enterprise has been regarded by this doubting element is somewhat significant. When the franchise was originally secured the city was blest by one car line only, and this had dingy bob-tail cars drawn by mules, which, on the heavy grades characterizing the topography of Richmond, made very slow time. The new districts were not reached at all. When the present line was proposed there were not wanting philosophers who knew that no road would be operated. Even when the tracks were down these same wiseacres predicted that no cars would ever move over them, and most certainly if they did, the time-honored mule would be called upon for duty. Even after the cars were put on the line experimentally there existed but little faith that success would be reached. But times have changed. The mules on the competing line are to give way to electricity. The citizens of Richmond are the strongest friends of the electric railroad of to-day, and as regards the street railway community elsewhere, the work which the road has done and is doing and the acceptance of the contract, speak for themselves.

The difficulties we have met are many. One of the most annoying at first experienced was that the cars frequently jumped the tracks. A large portion of the track was, as has been stated, laid in macadam, and dirt streets, the latter being chiefly in new districts and in a soil of which the chief component was red or yellow clay, and although the curves were of sharp radius, only one guard rail was used, and they were not bound in by paving. The winter months brought frequent and heavy rains. The tracks were found to be settling out of sight in mud, and especially at the curves they were spreading. The cars being large and heavy, with a 4 foot 8½ inch gauge and a 6 foot wheel base, helped to make the curves spread by the tangential pressure of the forward wheels on the outer rails. Mud and stones would get into the grooves, and the cars having a tendency to go ahead instead of being pulled around by the head as with horses, would climb the track, and before an inexperienced man could check them the wheels were down five inches in the mud alongside the stringer pieces and the track brakes hard and fast against the tracks. Sometimes it was lifting, sometimes prying, and sometimes a heavy hard pull on the part of the motors to get them back again. Experience, however, is a great teacher. Among other things which has been taught is this, that money will be saved by a good track construction and the observance of a few practical points. All curves should be bound in and paved, and this has since been done in Richmond. They should likewise have two guard rails, because it is much easier to steer a car by its rear wheels by holding them in place, than by allowing them to crowd the inner rail and force the forward wheels to climb the outer one. In dry weather, with the large wheel base and sharp curves, it is found advisable to grease the grooved rails.

Another point which has to be carefully taken care of is the character of switch which is put in for sidings and cross overs. If drop switches are used, they should be of such character as to allow the car to come down easily; tongue switches are now being put in on all the new work which is being done. It is a rare thing at present to have a car leave the track. I have seen a car in the winter propelled for a hundred feet off the track, and also leave and go back on its own account.

The power house is situated two blocks away from the nearest point of the line, and is almost equi-distant from its extremities. As a distributing point, it is, therefore, both theoretically and practically, a central station. In the construction no expense has been spared, and the performance of the station has justified it. The battery consists of three cylindrical return tubular boilers of the latest pattern, mounted on a Jarvis patent furnace, their capacity being 125 horse power each. The water is taken from the city mains or from a well. All feed-water connections are of brass pipe. From the pumps the water passes first through the feed-water heater, where it is heated from 150 to 200 degrees F. From there it goes to the filter. The draft in the furnaces is regulated by an automatic steam damper regulator, which, with anything like regular firing, keeps a pressure within two pounds of that for which the regulator is set.

The boilers all feed into one main feed steam pipe, which in turn leads to a separator, a large iron cylinder into which the steam passes, the water falling to the bottom, and the dry steam being carried off at the top. All live steam pipes in the boiler room are covered with magnesia.

The present battery occupies less than half the available space in the boilerroom, so that four more boilers can easily be put up when it becomes necessary to enlarge the plant. Two more have just been added. An important feature of these boilers, which are the source of power of the whole system, should not be overlooked, that is, the quality of coal burned. Where a very perfect combustion is obtained a grade of coal can be used which would be impracticable in an ordinary furnace; the mixture at present being used is two parts screenings to one part bituminous, costing from $1.75 to $2 per ton delivered. As the station is only three hundred feet distant from the depots of three railroads, coal can be obtained almost at the door. From the boilerroom, both the steam and exhaust pipes run in an underground, mineral-wool packed trench to the engine room.

The railroad engines, of which there are at present three, are of the Armington and Sims high speed type, and develop when running at full load 125 horse-power each at 250 revolutions.

Each engine drives two special Edison dynamos of 40,000 watts capacity each, wound for 500 volts maximum pressure. The dynamos feed into copper "bus" bars, supported on the walls by porcelain insulators.

Each machine has its independent ampere meter, and in addition there is a general ampere meter at the end of the positive "bus" bar From this bar the current passes to four snap switches, each switch being connected through a three-plug safety switch block to one of the feeders supplying current to the main line wire. These fourfeeder wires tap into the line wire at different points, thus maintaining the pressure approximately equal all along the line. At the ends of one of the feeders in the central station pressure indicators are to be attached which will indicate the voltage at the junction of one of these feeders with the main current wire, and this will serve as a guide.

The electric circuit consists of two parts—the overhead and the ground circuit, each being of compound character. Along the curb stones at distances of 125 feet are thirty-foot poles, inserted into the ground a distance of five feet. Great difficulty was experienced at first on account of the clayey character of the soil, and it became necessary at the corners to put in very heavy poles, which were embedded in concrete and stones to prevent settling out of place after heavy rains. These poles carry the main circuit which extends throughout the entire length of the roads, and is a copper wire three-sixteenths of an inch in diameter; this is called the main conductor, for on it depends the operation of the road in case of accidents or repairs to the contact wire.

The arrangements of main and working conductor are as already set forth.

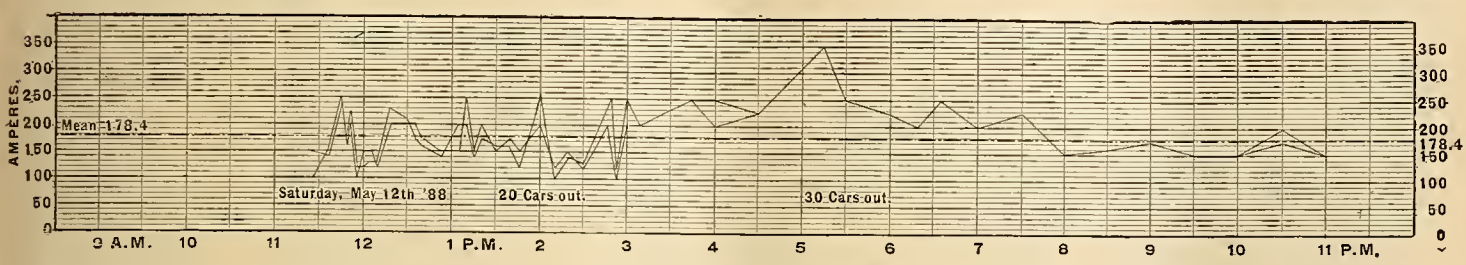
This main conductor is, as stated, supplied at widely separated points by feeders, which come from the main supply at the central station. Without the use of these feeders, which can also be reinforced if necessary, the size and cost of the overhead conductors would be very largely increased. The curves are formed of a series of short cords, which approximate the central line of curvature.

The current is taken from this working conductor by a light structure on top of the car. This consists of a low skeleton framework which carries an adjustable swiveling trunnion, having at its upper end a jaw in which is suspended a counter balanced trolley pole, having at its extension a grooved wheel held by a spring against, and making running flexible contact with, the under side of the working conductor. The flexibility of this arrangement is very great, it being able to follow with perfect facility variations of the trolley wire two or three feet in either horizontal or vertical direction, at any speed, and around any curve. What is all important, it relieves the line of strain instead of adding to it. When getting to the end of the track this trolley trunnion is swung around so as to trend in a proper direction abaft the center of the car. If off the line, it can be replaced from the car quickly and easily in the darkest night. From the trolley the current passes through a protected wire to the lightning arrester and thence to two switches, one at each end of the car, whence after whatever commutation is necessary, it goes to the motor circuits, and thence to the wheel frame.

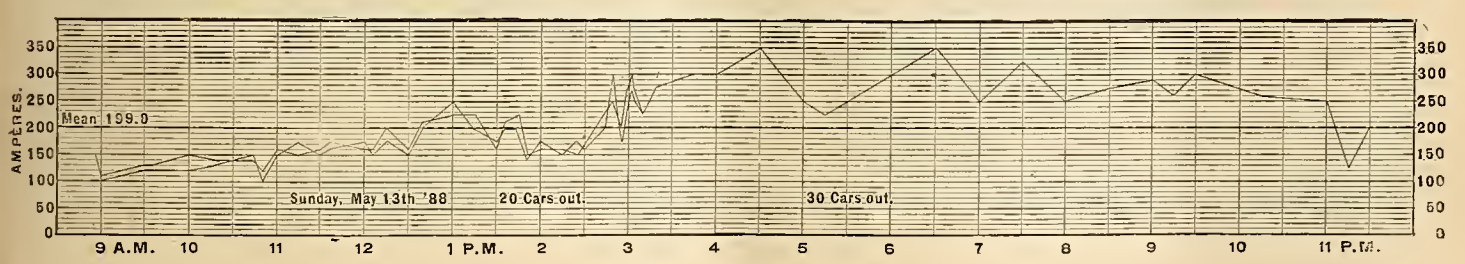
The return circuit is through the track, and thence by both metallic and ground circuits to the station. Each section of rail is joined to a copper ground wire, which runs throughout the length of the road underneath or alongside the stringer pieces, which is to prevent appreciable differences of potential existing between the rails; as a further precaution, at intervals of 500 feet this ground wire is connected to an earth plate, and at seven points widely distributed, these ground plates are supplemented by heavy iron pipes sunk into iron ore, or 12-inch water wells, about 25 ft. deep. The ground wire is connected to the station, and there is also a main ground connection made there in a thirty-foot well through a large sink plate, and another to the entire waterworks system. Some modifications of the overhead system are now being made which will make it impossible for any accident to one section of the line to disable the remainder; will enable the different sections to be operated independently; and, in case of a fire which may necessitate the blocking or temporary disabling of one part of the line, will allow this section of the line to be cut out of action either automatically or at will.

Each car is fitted with a duplicate and a very powerful motor equipment. This is carried entirely beneath the car body, is very compact, out of sight, and necessitates no radical change in the construction of the car. The body had to be stiffened a little and three-inch steel axles put in. One of the great objections which have been met with in applying motors, whether steam, electrical or of any other character, to the propulsion of street railways, has been the difficulty of getting sufficient track adhesion to operate the car under all conditions of track, loads and grades. Especially was this objection true in Richmond, where it was manifest that no application of a motor system could be fully successful unless the entire weight of the car and its contents was made available for traction.

One of the manifest reasons is, of course, the slippery character of the track under many conditions. Another thing should also be noted, and that is that it is almost impossible in practice to cast all wheels of exactly the same circumference, or at least so that the paths described by the lines of contact shall be the same. Moreover, on curves the wheels are all traveling over paths of different lengths. Theoretically, the wheels should be independently driven, but since this is not possible it follows that the next best thing is to drive each pair of wheels independently. It is a fact which admits of no dispute that there are conditions of



AMPERE DIAGRAM FOR MAY 12, 1888.



AMPERE DIAGRAM FOR MAY 13, 1888.

track which will not permit of a car being driven from one pair of wheels only, and this difficulty is often augmented by the fact that if one pair of wheels only is used they will sometimes be leading, sometimes following; on heavy grades with one platform reserved for the driver there is a very serious displacement of the center of gravity and there may be very much more weight upon one pair of wheels than on the other. The whole experience in Richmond has been to emphasize the value and necessity of independently driven axles.

To accomplish this, one motor is centered upon each axle, and to allow the required freedom of motion, and at the same time to preserve pefect parallelism in the meshing of the gears, and also for taking part of the weight of the motor off the body of the axle and to throw it on to the journals, one end of the motor is supported by double compression springs playing upon a loosely suspended bolt, which is supported from a cross girder in the bottom of the car.

The motors are, then, so to speak, weighed or flexibly supported from the car body, and the motion of the armatures is transmitted to the axles through intermediate gearing, of compact form and great strength, so that whenever the axles are in motion there is a spring touch of the pinions upon the gears. Barring friction a single pound pressure exerted in either direction would lift or depress the motor a slight amount, and no matter how sudden the strain, whether because of a variation of load or speed, or a reversal of direction of rotation, it is impossible to strip the gears unless the steady strain exceeds the strength of the iron, the pressure on the gears always being a progressive one. The motor armature makes nearly twelve revolutions to each revolution of the car axle.

The motors, although in one sense independent, are connected with duplicate switches at either end of the car which afford simultaneous control of both machines. These motors, which are of normal capacity of seven and a half horse power each, can for a short time work up to thirty horse power, and are capable of producing a tractive effort of over three thousand pounds at 50 per cent. efficiency.

The machines are controlled by a single movement switch which effects the various communications and reversals. They run with fixed brushes in both directions and under all loads. They are run without any covering, and I have no doubt of having street car motors in such condition soon that the cars will be run over a pit, and the machines washed down with a hose.

The cars can be run at widely different speeds, varying from the slowest crawl to twelve or more miles per hour. They can be started and stopped without the use of brakes in the space of three or four inches, and when making the normal running speed can, in an emergency, be stopped and reversed without brakes within less than a quarter of a car length. The starting, although prompt, is easy and without shock or jar.

Emergencies sometimes bring out qualities of motors which are unexpected, or which at least if counted on are rarely ever brought into play. On one occasion a man was descending a six per cent. grade with a heavy load when his brake chain parted. Seeing a sharp curve right ahead of him which he knew he would leave if he struck it at the speed he was running, he instantly reversed his machines and brought his car to a standstill, and on the rest of his trip handled his machines entirely with the motors. On another occasion a man passing from behind one car directly in front of another was struck and knocked down by the dash board. Although the car was moving at a lively gait, the machines were reversed and the wheels stopped within a foot of the man. By any other method of propulsion he would have been killed. Frequently on a ten per cent. grade, with a loaded car, the brakes have been thrown off, the machines reversed, the car stopped and started backward up hill within less than one-half of its length, a test of the most remarkable severity.

In noting the control of the car, one is struck at the remarkable character of the traction, and cannot help wondering where it comes from; unquestionably it is in a large measure due to the fact that every pound of weight is available for traction, and that the two axles being independently driven, can take their own speed, and each pair get the best grip.

Another thing to be noted, where the ground circuit is used, is the increase of traction due to the passage of the current from the wheels into the rails. Exactly what molecular action takes place has not been ascertained; it may be simply heating at the contact surface, but the fact remains that the traction is very largely increased. The magnetic condition of the wheels and tracks also has some function in this increase of traction. The wheels and axles are magnetized by the method of motor construction and mounting, and also by the passage of the current through them; the tracks are likewise magnetized by the current passing through them, and also by the rolling contact of the wheels. Yet, admitting all these aids, the results have been extraordinary.

Sixteen-foot closed cars carrying picked loads of fifty-five to sixty passengers, and having a total weight of 15,000 pounds, are operated on the ten per cent. grade, often with a slippery and slimy rail, and on 27-foot curves, without the use of sand or extra help.

These same grades and curves have been ascended without sand after one of the worst sleet storms which has visited this section for years. Various tests under the most unfavorable conditions have been made, cars often being required to cut their way through clay, snow and ice, when the tracks were out of sight. No severer test could have been made, and the power and tractive effort developed have exceeded the most sanguine expectations.

I have no hesitation in saying that with a clear track, and with proper gearing, these cars could mount a 15 per cent. grade, depending on adhesion alone. During the four months operation, although there have been troubles, and changes havebeen made while the cars were running, commercially, no car has been pulled a foot by animal power; if any accident has occurred to a motor the car has gone along with one machine, oftentimes with heavy loads and on heavy grades, or in some cases has gone home in company with another car. One hundred and forty men who did not know the difference between a motor and a hand-saw, have been broken in to handling these cars; oftentimes with remarkably short training. Up to Saturday, May 4th the number of regular cars on duty had not exceeded twenty. On that day at 4 P. M., the hour when traffic becomes exceptionally heavy, we began putting out ten open cars, starting them from the eastern carhouse alternating with the closed cars, but finally banking them all up at the Old Reservoir. At 6 P. M. they were started home, and shortly afterward these ten open cars, headed by a closed car, were all run at full speed close together down the eastbound track of Clay street. At one time fourteen cars were on the line between Clay and Hancock streets and the Old Reservoir, and shortly before 7 o'clock there were about twenty-two cars on the line between Capitol Square and the Old Reservoir, and at 7 o'clock thirty cars were on the line, the closed cars being very heavily loaded, many of the cars being run with two minute intervals. The three boilers, whose capacity is 375 horse power, were then supplying three Armington & Sims engines of 125 horse power capacity, which were driving the six railroad dynamos, and two Westinghouse engines of 110 horse power capacity, which were driving two alternating current dynamos and exciters, with an equivalent load of 1,060 incandescent lamps. The mixture was enriched and the firing of the boilers became pretty active, there being in addition to the thirty cars badly banked about 110 horse power taken for lighting.

The highest reading, however, on the line was less than three-quarters the normal capacity of the dynamos, which were originally intended only for thirty cars, and the average reading for this number was only a trifle over half the normal capacity. Some idea of the effective work of the automatic steam regulator can be formed by an inspection of the steam diagram for May 4th and 5th.

The ampere readings taken at intervals of ten and fifteen minutes give a load diagram which is really higher than a continuously recording instrument would show.

The figures which follow, being based upon an actual service increasing from eight to thirty cars, and extending over a period of four months under the most trying circumstances, and the most critical and care-requiring period of the enterprise's existence, we give street railway men the most careful and liberal estimate of every possible expense attending the operation of the road which is in any way dependent upon its electrical features. The operating expense is given under two heads; first, the central station operating expenses, and second, the road operating expenses, the two constituting the total cost of motive power. These are given in detail, and they will probably be found to cover every expense, although in some small ways the distribution of these expenses may be found to be changed by several months longer running. The fuel and other incidental expenses of the station are from the engineer's record, and checked by the readings of the electrical instruments.

(To be continued.)

High Tension System Before the Board of Electrical Control.

PART I.

At the meeting of the Board of Electrical Control of New York, June 8th, Commissioner Gibbens read the following letter:

HAROLD P. BROWN'S LETTER.

"*To the Editor of the Evening Post:*

"Sir:—The death of the poor boy Streiffer, who touched a straggling telegraph wire on East Broadway on April 15th, and was instantly killed, is closely followed by the death of Mr. Witte in front of 200 Bowery and of William Murray at 616 Broadway on May 11th, and any day may add new victims to the list. After every such accident the newspapers clamor to have the wires placed underground, while the electricians connected with the system at fault hold their peace or throw the blame on the telephone wires, until the matter has been forgotten. As an electrical engineer I know that burying the wires would not remedy the trouble, though it would largely diminish the risk, while the enforcement of a few common sense regulations would make it almost impossible to kill a man from an arc light current. It will not do for electricians to state that they 'don't know what killed that man,' for unless they take prompt measures to make their business safe some terrible accident will cause the adoption of laws to regulate electric lighting, which, being framed by their enemies, will cripple or destroy their business.

"So, at the risk of offending some corporations having heavy investments in unsafe systems, I will venture to state a few facts which I trust the press will be kind enough to publish widely, as no disinterested electrician will deny my statements.

"It is well known that a continuous current of low tension, such as is used by the Edison company for incandescent lights, is perfectly safe as far as life risk is concerned. From this fact the false popular impression has arisen that all incandescent systems are safe and all arc systems dangerous. But it is not to the low tension alone that this current owes its safety, since a factor fully as important is the even, steady quality of its delivery. That is, a current of high tension, but unbroken and continuous, *may* be perfectly safe if properly operated, while a current of lower tension, but wavy or pulsating, is *always* dangerous. And when these pulsations rise in speed and intensity the danger increases, until the climax is reached in what is called alternating current, in which impulses are given first in one direction and then in the other, several thousand times a minute.

"To understand the reason for this it is necessary to remember that when a current through a wire or other conductor is made or broken, a current in the opposite direction is induced in any parallel conductor; the same effects are produced in a less degree when the first current pulsates, but are intensified when it is alternated or reversed in direction. Any one who has held the metal handles of a medical (Galvano-Faradic) battery, has had a practical experience of the power of induction and pulsation; in this apparatus the current from the battery itself is so feeble that it cannot be detected without the use of instruments, except by the metallic taste when the terminals are touched by the tongue. This insignificant current is passed through a short piece of insulated wire coiled around an iron core, and is interrupted by a rapidly vibrating armature and thereby inducing in another and longer coil of wire surrounding the first a series of shocks whose intensity can produce the most intense suffering or even death in a human being who forms a portion of the circuit. It is this rapid succession of shocks that kills, while a single steady impulse of the same intensity would do little damage.

"Two of the leading arc lighting systems have dynamo electric generators provided with what are known as open-circuit armatures, which produce a pulsating current somewhat similar in kind to the one just described, though a thousand times more powerful. It is to this current that nearly all the deaths caused by the arc lighting systems must be attributed. These open circuit armature systems were pioneers in electric lighting, and at the time they were invented it was supposed that the closed circuit armatures, which produce the steady and safer current, could not be made to develop sufficient electromotive force to operate a number of arc lights upon one circuit. But the recent advances in the science have made possible closed circuit armature generators which give the same amount of current and electromotive force, with a much less expenditure of motive power, so that there is now no valid reason for the existence of the old type with its pulsating and dangerous current.

"I do not mean to have it understood that the steady current is always safe or that the pulsating is always unsafe, for any current with more than fifty arc lamps in series is dangerous and should be prohibited; while the pulsating current, if its circuit is kept thoroughly insulated and carefully watched, and tested every day, may run for years without a fatal accident. But the fact remains that the steady current, with fifty or less lamps in circuit, has had, to my knowledge, but four victims against the scores killed and maimed by the pulsating current. And even these four were responsible for their fate, since all were employes and should have known better. Three of them tried to disconnect apparatus through which they knew the current was flowing, and thus got into the circuit, while the fourth received the full current while trying to repair a broken wire which he knew was charged.

"But the persons killed by the other system, as a general thing, have been in no way responsible for the accidents that caused their deaths; they have, as did young Streiffer, touched or run against an apparently harmless wire when standing on a damp place, or have touched at the same moment some metal accidentally charged with the fatal current, and some other conductor having a ground connection, as did Mr. Witte. I do not believe with extremists that the pulsating current should be prohibited, but I do think that the conditions of safety should be rigidly enforced by the authorities.

"If the circuit carrying the pulsating current is perfectly insulated at all times, no accidents are likely to occur. But if, through wearing of the insulation or a heavy rain, a connection between the circuit wire and the ground is formed, any one who touches the wire and a ground will receive a portion of the current; if he happens to be near the other ground, he receives but a small shock, but if there are a number of lamps between him and the other connection, the shock may be fatal.

"Of course the reply will be made that all the arc lighting stations in this country use insulated wire, 'as required by the underwriters,' but here is just where a great mistake has been made, and the sooner this is corrected the better for the cause of electric lighting. It is an open secret among electricians that the wire known as underwriters' wire has a very poor insulation, even when new and during dry weather, but practically no insulation at all during a rain. The paint dries out of it after a few months' exposure, other wires rubbing against it soon wear away the cotton and expose the metal, and it is altogether unfitted for outdoor use. Among electric lighting men it is appropriately called 'undertakers' wire,' and the frequent fatalities it causes justify the name.

"Even with the most conscientious electric light superintendent, who tests his circuit carefully for grounds every day, before starting the generators, there is no surety that during the run some telegraph wire may not drop upon his circuits, wear away the insulation, and set a death-trap for the unwary who may be miles away from an electric lamp.

"The condition of the electric light circuits in the lower part of the city is simply disgraceful, as has been previously pointed out. Most of them were first put up years ago; they have been cut and patched until full of joints, from which the tape flutters; the insulation is entirely worn off in places or hangs in shreds, and few circuits are fit to run with safety for a single hour. They cross and recross the structures of the elevated roads; they sag and sway in loose loops, and are intersected at all levels by telephone and telegraph wires. On some of these circuits two or more dynamos are run in series, thus more than doubling the life risk, and it is almost certain that it was these overloaded circuits that killed Streiffer and Witte.

"If the Board of Electrical Control cannot force the wires underground, they can at least condemn these lines, which the companies can afterward utilize by reinsulating, for their underground circuits. The underwriters ought to have an eye to this also, for every bare or poorly insulated spot is a menace to property as well as life.

"But if 'influence' prevents the wires from being replaced, and it seems to permit the extension of new wires elsewhere, there are a few simple precautions which, if enforced, will make fatal accidents almost impossible. All the deaths due to arc lighting, as far as reported, have been caused by the victim's breaking the circuit and placing himself in the break to receive the fatal extra current thus caused, or by his making a ground connection with a circuit on which there was another ground. Both of these dangers can be avoided by very simple apparatus.

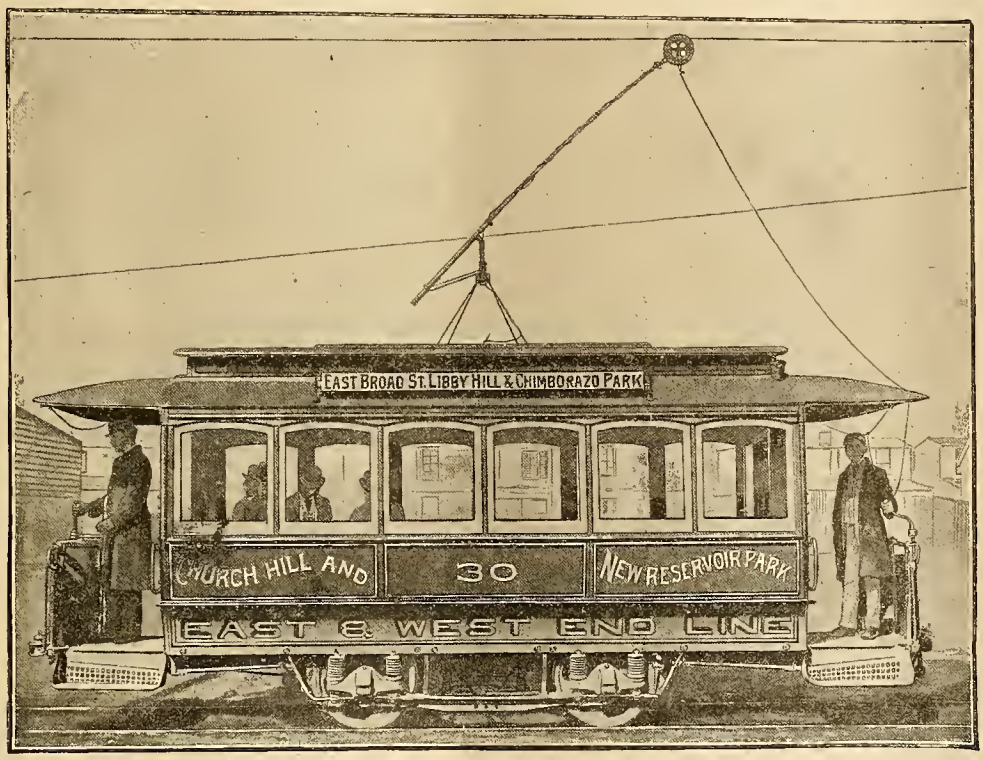
"If a voltameter, or a circuit of very high resistance, be connected across the poles of every arc light dynamo, the external circuit may be opened without producing the death flash, as most of the extra current will go through the by-pass. This would prevent a large proportion of the fatal accidents. If every arc light dynamo was also provided with a wire of very high resistance leading from the circuit to the ground, upon which was interposed apparatus to shut off the production of current the instant a second ground occurred, no deaths could be caused except by foolhardy carelessness. The latter apparatus could also be used to shut down the current in case the external circuit should be broken.

"With these precautions, and with the number of lamps limited to fifty on a single circuit, even the pulsating current would be fairly safe, but as the stations are now operated upon circuits with frayed and worthless insulation, they are a constant menace to all who walk the streets, use a telephone, or touch a wire.

"In regard to the popular impression that all incandescent electric lighting systems are safe, I am sorry to say that recently several companies who have more regard for the almighty dollar than for the safety of the public, have adopted the alternating current for incandescent service.

"If the pulsating current is dangerous, then the alternating can be described by no adjective less forcible than *damnable*. With the pulsating current three contingencies must ordinarily arise to produce fatal results: There must be a ground connection on the circuit; a person must touch the circuit at some distance from the first ground, and must at the same instant be in connection with the ground himself. But the alternating current produces

(*Continued on page* 45.)



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CONTENTS OF THIS NUMBER.

Thomson-Houston Electrical Railway System. Illustrated..... 37
Bell Victorious over Cushman..... 38
Irish's Conduit for Electric Wires. Illustrated..... 38, 39
Auditorium Electric Plant..... 39
Heat from Electricity..... 39
Phonograph and Graphophone Controlled by One Company..... 39
The Solution of Municipal Rapid Transit, by Frank J. Sprague. Illustrated. Part II..... 40, 41, 42
High Tension System before the Board of Electrical Control. Part I.
Harold P. Brown's Letter..... 43, 45
Communication from T. Carpenter Smith..... 45
Communication from S. C. Peck..... 45, 46
Communication from M. M. M. Slattery..... 46, 47
Communication from Ralph W. Pope..... 47
Communication from Professor Henry Morton..... 47
Editorial..... 44
Okonite Conductors..... 48

DEPARTMENTS.

Correspondence..... 48, 49
The Electric Light..... 49
The Electric Motor..... 49
The Telephone..... 50
The Telegraph..... 50
Electrical Patents..... 50

A ROCHESTER, N.Y., paper from which an extract is published in another column, describes the energetic construction of the long distance telephone line. This means of communication is daily becoming a more formidable rival of the telegraph.

GOSSIP has centered to a great extent upon the Atlantic cable during the last week. It has been an exceptional day when a new rumor and a new denial did not appear. The report that the rates were to be doubled is true; the other stories in circulation seem to have no foundation.

AN important transaction during the week was the purchase of the phonograph patents by Jesse H. Lippincott of New York, for the North American Phonograph company. The organization will control both the graphophone as well as the Edison instrument. Now that these instruments are perfected, they will have a future before them, and the company which proposes to put them on the market next fall will doubtless find a large demand for these reproducers of speech.

THERE is a man in St. Louis confined to his room as a result of an accident on a cable car, in which both his wrists were fractured. The curious feature of the case is that the victim is a hearty believer in the cable car in spite of his misfortune, and in an interview in a St. Louis paper predicts the triumph of the grip road over the electric railway. The St. Louis man is more forgiving than the great majority of men. He is a curious study, both on account of his strange preference and his amiable spirit.

WE publish another installment of Mr. Sprague's solution of the municipal rapid transit problem in this issue. The paper is lengthy, but the subject treated in the exhaustive manner in which Mr. Sprague has handled it, is a vast one. Well nigh every line of the paper teems with knowledge, valuable data or suggestions. We look upon it as one of the most valuable contributions to electrical literature upon the subject of electricity applied to street railways that has ever been put in print and therefore can reiterate our commendation of it to careful perusal.

THE London *Electrical Review* laments the fact that English electricians are devoting so much time to electric launches and urges them to confine themselves to the solution of problems connected with street railway motors. That paper adds: "Street tramways will never be successfully worked by electric locomotion in this country if we do not try to emulate the *nil desperandum* spirit of our American cousins and stick at the subject with the determination to overcome all obstacles, and at all costs."

IT IS said to be a fact that dynamo tenders and those who are constantly about electric light machinery are free from one of the ills which afflict so many human beings—rheumatism. Superintendent Law of the Brush company in Philadelphia is cited as authority on the subject. He is quoted as a great believer in the curative effect of currents of high potential, and is said to have given many instances of the departure of ailments of various sorts after the subject had been treated to a rather uncomfortable shock.

PROFESSOR THURSTON says in an article in the *Forum* that the world is awaiting the appearance of three inventors greater than any who have gone before. The first is he who will show us how, by the combustion of fuel, directly to produce the electric current; the second is the man who will teach us to reproduce the beautiful light of the glow-worm and the firefly, a light without heat, the production of which means the utilization of energy without a waste still more serious than the thermo-dynamic waste; while the third is the inventor who is to give us the first practically successful air ship.

THE decision of Judge Blodgett in the Bell-Cushman litigation will be found in substance in another column. The findings of the court are sweeping in character and sustain the position of the Bell company at every point. The defendants do not propose to give up the fight yet, but propose to carry the contest to the United States Supreme court. They express confidence in their ability to win victory eventually. The Bell company seems to have no trouble in showing that it is entitled to exclusive privileges under its patents. In all its suits it comes out with flying colors, and almost every week a new legal victory is gained.

Judge Blodgett is to be congratulated upon one feature of the case at least. He entered into the case ignorant of every branch of telephony; he took occasion to explain this fact to the attorneys at considerable length, as has already been mentioned. His decision, however, gives evidence of great familiarity with the subject; and the learned court emerges from the case well equipped with telephonic knowledge.

THE Phonograph-graphophone is to be the new name of the instrument controlled by the North American Phonograph company. The composition of the individual members of this name, it will be noted, is practically the same, i. e. the roots of each member are found in the Greek words *phone*, sound, and *graphein*, to write. Mr. Edison preferred to call his instrument, by free translation, a sound writer, while the Graphophone company preferred to call their instrument by as free translation, a writer of sounds; consequently, the instrument to be rented to take the place of stenographers, etc., is a sound-writer—writer-of-sounds. Hereby hangs a tale: It is said that the question of finances in the transfer of the Edison instrument to the Graphophone company was quickly settled and that too, some months ago. Then arose the question: What shall the instrument be called hereafter? Mr. Edison was strenuous that "phonograph" should be retained and his persistence in this is not to be wondered at inasmuch as according to common report the phonograph is his pet invention. On the other hand the Graphophone company wanted their name preserved, and it took weeks, and even months to settle the question, which resulted in the double name "phonograph-graphophone" manufactured, not by the American Graphophone company, but by the North American Phonograph company.

THE central section of Chicago will soon be lighted by arc lights run from the city's own plant. The 500 horse power engine will be ready in about a week. The work of extending the wires for street lighting is being done rapidly, and if all goes well the current will be turned on in about five weeks. The central station will be located on Jefferson street, near Van Buren street. The east side district first to be lighted will be between Michigan avenue, Madison street and the river; the west side district will be between Van Buren, Halsted and Washington streets, and the river.

As large a section will be lighted as the appropriation of $35,000 will permit of. From Rush street bridge one system of street lamps will be extended down Michigan avenue to Madison street, and thence west to the river. It is expected West Madison street will be lighted as far west as Western avenue.

A COMMUNICATION, signed by Harold P. Brown, appeared in a newspaper in New York city, and was drawn to the attention of the Board of Electrical Control. Mr. Brown denounced the alternating current and offered for the consideration of the board a list of rules which were practically prohibitive of the alternating current for central station lighting. The board invited those interested to present their views of the proposed rules, and the invitation was accepted, as our columns well attest. The discussion in a great measure deals with the danger to human life from the alternating current, and the data brought out in the part published this week and that to follow in the next issue is very interesting, one writer claiming that no death has ever occurred by a shock from an alternating current circuit, while others testify to having received shocks from circuits of 1,000 volts without much inconvenience.

The series of discussions by the Chicago Electric club laid before the readers of the WESTERN ELECTRICIAN and this supplementary discussion before the Board of Electrical Control, upon the comparative value of the continuous and alternating currents for central station distribution must impress upon the mind of every candid and impartial man that each system has its advantages, that each has a well defined place and that neither can occupy the whole field. With either system the world is better off than it was before the electric light was introduced, and with both systems the world is still better off than with one alone. The continuous current has demonstrated its value and the alternating current has shown its value. Neither can be relegated to the curious and interesting but commercially useless products of the laboratory.

We believe the true origin of this discussion in New York is not to be found in the strong advocacy of one system by one of its adherents, but in the reckless manner in which overhead circuits in New York have been run and are maintained. We have referred to this time and time again and yet the strongest terms we have used cannot approach in severity those in T. Carpenter Smith's arraignment. A number of deaths occurred in New York and the cause was found to lie in poor and even reckless construction and maintenance of circuits. The public recognize the value of the electric light and are gradually appreciating the advantages of electricity as a means of transmitting power. The universal adoption of both in places where either is possible and under proper methods of installation is only a question of time; but in the case of New York, if the present system of construction is continued, the use of either is bound to be limited, and confidence in either will wane until it is entirely lost. Control, not prohibition, is the pithy way in which one writer, Mr. Peck, sums the matter up. That is it exactly. If those interested in line construction will not do their work properly, they should be put under the control of a plenipotentiary who will make them do the work properly.

(*Continued from page* 43.)

fatal results by simply touching the two parallel wires, always close together, connections from which enter every house. Its supporters may say that on account of its danger they do not permit the primary, or death-current, to enter the house, but supply the lamps from the secondary current. True, but between these two circuits is interposed nothing more than a thin layer of cotton or silk insulation, and, as has happened again and again, it requires but a flash of lightning or a little moisture in the converting apparatus to bring the death-current to each lamp.

"The only excuse for the use of the fatal alternating current is that it saves the company operating it from spending a larger sum of money for the heavier copper wires, which are required by the safe incandescent systems. That is, the public must submit to *constant danger from sudden death* in order that a corporation may pay a *little larger dividend*. I do not know of a single disinterested electrician of high standing who does not condemn the alternating system. Siemens & Halske, a firm of electricians with a world wide reputation, have spent years of experiments upon it, but have abandoned it as unsafe, and say that its use should be prohibited by law.

"Following the example of Chicago, the Board of Electrical Control should forbid the use of the fatal alternating current, and legislatures, city councils, and life insurance managers should see to it that stringent laws and regulations be passed to prevent this wholesale risk of human life. The placing the wires of the alternating system underground would only intensify the danger in houses where it might be used, while its use with the underwriters' wire in a city like this is as dangerous as a burning candle in a powder factory. If the death of these three men can effect the adoption and enforcement of regulations similar to the following, they will not have died in vain.

"RULES FOR STATION LIGHTING.

"Not more than fifty arc lights shall be operated upon any one circuit, unless said circuit is used exclusively for street lamps mounted upon wooden poles; in this case the number must not exceed sixty.

"All outdoor arc light circuits must be provided with waterproof covering having an insulation resistance of not less than one-half a megohm. Any circuit falling below this must not be used until restored.

"No arc light dynamo shall be operated unless provided with a voltameter across its terminals, or other device, to provide a path for the extra current caused by opening the external circuit.

"No arc light dynamo shall be operated unless provided with means for automatically stopping the production of current the instant a ground connection is made upon its circuit.

"No arc light dynamo shall be operated unless provided with means for automatically breaking or short-circuiting the field circuit the instant the external circuit is broken, in order to prevent a current from being built up by the broken circuit ends falling upon some conductor

"No alternating current with a higher electromotive force than three hundred volts shall be used.

"HAROLD P. BROWN, Electrical Engineer,
"201 West Fifty-fourth street, New York, May 24."

In order to give an opportunity of replying to the letter, invitations were extended to the various electric lighting companies interested, and a day appointed for the hearing of arguments as to the necessity of adopting the rules proposed by Mr. Brown. The meeting was postponed from time to time on account of the death of the daughter of Secretary Moss of the Board of Electrical Control, and was finally held in the lobby of Wallack's Theater, July 16th.

Upon the calling of the meeting to order, Commissioner Gibbens announced that the board was ready to listen to all who were interested in the subject. Communications were then read before the meeting as follows:

COMMUNICATION FROM T. CARPENTER SMITH.

W. H. Browne, esq.: New York:

PHILADELPHIA, Pa., June 12.—Your favor of the 9th at hand, in which my attention is called to an article in the New York *Evening Post*, of June 5, 1888, headed "Death in the wires," signed by Harold P. Brown, electrical engineer, which contains some sweeping assertions and also lays down the law in a manner to which I am sure no practical electrical engineer would commit himself.

Mr. Brown's statement that no disinterested electrician will deny his statements, I think is very correct. Some of his statements are hardly worth denying, and it is only the fact that they are apparently published in the interests of a particular corporation, and for the purpose of taking advantage of the fears of an uninitiated and justly anxious public, that makes it worth while to answer any of them.

If Mr Brown had confined himself to showing that the three deaths he quotes were all caused by neglect of the most common precautions, he would have done far better service than by entering into a quasi-scientific disquisition which the general public cannot understand, and which is so full of absurdities as to show that he has either the little knowledge which is so dangerous a thing, or is a deliberate attempt to make a good case by false inferences. The one point plain in his article is that the system of one particular company is perfectly safe and all others are dangerous, and that one in particular should be wiped out of existence. One of the deaths which Mr. Brown cites, that of Mr. Witte, was reported as caused by a "closed circuit," "shunt-wound" machine the very one he calls the "steady current" which has only four victims against the scores killed and maimed by the "pulsating current," the fact being that the "pulsating current" has tens of thousands of arc lamps where his much boasted "steady current" has thousands. It is as though he had claimed that only four men had been killed while traveling on horseback in New York city, while scores had been killed on the elevated roads—therefore it is safer to ride horseback than by railroad.

I have been running electric lights, both arc and incandescent for the past seven years, and have never known of a case where it was conclusively proved that a man was killed by the electric current, without there having been gross carelessness in some direction. Mr. Brown could very easily have accounted for every death that has occurred in New York (as far as I have been able to follow them) by the condition of the wires alone. Any man who would undertake to run belts carrying thousands of horse power, even in a factory where none but skilled help are employed, in the unprotected way in which wires are run overhead in New York city, would be universally condemned. I never walk in the streets of New York but my blood boils to see the criminally dangerous and reckless manner in which wires are strung through the streets. They are placed, not on poles, but on stumps, and wood exposed to the weather, seems to be a good insulator. The so-called underwriters' wire covering seems to have been originally the standard, and even that is worn off in many places for several feet along the wires, while the whole air is full of dead and rotten telegraph, telephone, burglar alarm and district call wires, any one of which by falling across an arc light circuit, becomes itself as dangerous. It is an absurdity for Mr. Brown to talk about lighting stations and "simple rules and precautions" to be enforced therein. No precautions at the station, however valuable they may be in themselves, can render electric lighting safe, when the outside circuits are in this condition.

It is this outrageous and inexcusable carelessness which has led to the cry for "underground wires"—a cry that has so much real foundation that we may well excuse the often rabid insistence of its utterers. The fact that the wires are in this condition in the largest city in the country, is taken as a proof that they are in a similar condition in every city and cannot be made safe, and paper after paper reiterates the senseless shriek against the horrible danger of overhead conductors, without any reference to the manner in which they may be installed. An overhead wire with properly soldered joints and waterproof insulation, with insulated tie wires, and kept clear from all ground contacts on buildings and trees, and out of reach from the ground, is as safe as any underground conductor that can be made, except in case of damage caused by fire, storms or external violence, in which cases the underground conductor has such an overwhelming advantage, that this plea alone should be sufficient to cause them to go underground.

I am an earnest advocate of underground wires and an interested one, but the claim that wires are dangerous simply because they are overhead, will only hurt the cause, for that reduces it to the level of the outcry against the introduction of railroads, or gas, or any new improvement. There are enough fair arguments against overhead wires without resorting to clap trap or trickery. If Mr. Brown kept himself posted as any one who wishes to pose as a general electrical teacher should certainly do, he might have noticed a report in one of the electrical papers of a painter who fell from the roof of a building in Pittsburg, and who saved his life by catching hold of the two opposite leads of an overhead circuit carrying one thousand volts of alternating current, by which he hung until taken down unhurt with a ladder. This is what I call good practice in overhead construction, high insulation and good solid work that your wires can stand the strain of a man falling twenty feet on them without tearing them loose.

Now for Mr. Brown's attack on which he has been pleased to call the "damnable alternating current." He evidently has not had the least experience with the alternating current as applied to electric lighting, and his information seems to have been derived chiefly from a gratuitously circulated publication of the corporation, the sale of whose particular apparatus is most affected by the alternating system.

In spite of all that has been said on this subject in the past year at the various electrical conventions, in spite of the published descriptions of the various converters manufactured by different companies, without taking the trouble to inform himself by actual inspection of a single converter, he again repeats the statement that I can characterize as nothing but the grossest ignorance of electrical manufacture, or a deliberate falsehood, that between the two circuits in a converter "is interposed nothing more than a thin layer of cotton or silk insulation," and he says, "that has happened again and again, it requires but a flash or a little moisture in the converting apparatus to bring the 'death current' to each lamp," showing his utter ignorance of the whole subject, not to know that in the first place only the lamps of one group would be affected by being extinguished, for in such cases the safety fuses would instantly melt and cut off the current. A more contemptible evasion of the real question at issue I have never seen than his reference to Siemens & Halske, as opponents of the alternating systems. Siemens & Halske abandoned the manufacture of alternating current apparatus for the same reason that Westinghouse abandoned their apparatus after having tried it, namely: because they could not make commercially efficient apparatus which would not overheat and burn up, and the fact is that Siemens & Halske are today making and selling the underground cables for alternating current work in Europe. These cables have one conductor in the center surrounded by an insulating material; the outer conductor is wound on the outside of this with a layer of insulating material, and the whole is then covered with a sheathing of steel tape, and Siemens and Halske recommend and guarantee these cables for use with an alternating current of five thousand volts. He says that he does not know of a single disinterested electrician of high standing who does not condemn the alternating current system. His acquaintance with eminent electricians must be limited. Why did the Edison company secure the control of the Zipernowski system as soon as the Westinghouse had made a market for the alternating current in this country? Why did the United States company secure the Jablochoff system for the same purpose? Are not Ferranti, E. J. Houston, Elihu Thomson men of high standing? Truly these men are all interested, but who are disinterested electricians nowadays? Professor Forbes of England is usually referred to as probably one of the best posted men, and the most thoroughly disinterested electrician of the day, and I myself heard him say at the electric light convention, held in Pittsburg last February, that the alternating system as installed in America, made him feel that we were far ahead of anything they had done in England, and that he had completely changed his opinion, and was now satisfied that the alternating system was safer than any direct current of the same tension could be. For persons who have absolutely no experience with electric lighting by alternate currents to refer to speeches made five years ago by electricians, however eminent, is folly, when we recall the history of the alternating system in this country. First, it was an impossibility. Then this was limited to its being a commercial impossibility, and when its adoption showed it was a success every pettifogging self-styled electrician, who had been engaged in proving it ridiculous turned his attention to proving that it was odd and that everybody knew about it years ago, and the very companies, who had been ridiculing it, both publicly and privately, turned their attention to foisting on the public the most unblushing and slavish imitations of the successful form of this apparatus, and which has excited the unqualified admiration of European electricians.

Now the fact is that it has been proved in a dozen cases that the alternating current while disagreeable, is far less dangerous to life than a direct current of the same tension. Personally I have received the full 1,000 volt current from an alternating current machine, not once but half a dozen times, and I have received the direct current in the same way, and, while the direct current will always make one sick for some time after the shock, the alternating current leaves no such effects. I have seen five or six men get this thousand volt alternating current shock direct from the machines. I have pulled one off who was hanging to the bare switch board wires and whose hands were badly burned, but who in half an hour was at work again, having in the meantime walked by himself to a doctor to have his burns dressed. Add to this that this high tension current is thoroughly insulated and protected from the house circuits by layer after layer of insulating tape, mica, fiber and by an open air space, and one can easily see that the danger of high tension reaching the house is very remote indeed.

Mr. Brown has chosen to exhibit his ignorance and bias by speaking of the lightning bringing the high tension at the house; that is to say the lightning to enter any one house by the alternate current wires, has to break down the whole insulation of the converter, while the direct metallic connection on the system which Mr. Brown is pleased to favor brings the lightning itself, with its tens of thousands of volts, direct to every lamp of the system, without the slightest check or hindrance. Yet how many persons have been killed by lightning coming in on such wires? No one that I have ever heard of, and Mr. Brown knows that this danger is infinitesimal or he is merely truckling to the prejudice in favor of direct current systems, when he makes any such statement.

He spoke of the Chicago board having forbidden the use of the "fatal alternating current." I presume he means the same board whose inspector read a paper before the Chicago Electric club, in which he showed the induced discharge from a single magnet as an instance of an alternating current. They will simply have to abandon this position. Would it not be a good deal more sensible to follow the example of the Philadelphia board which has simply placed the very strictest regulations (and what is a different thing, enforces them) as to the use of not merely alternating current apparatus, but of all apparatus, and came to this conclusion after a thorough inspection and test of the insulation and general construction of the alternating current system converters?

When Mr. Brown styles himself "an electrical engineer" he lays himself open to the pertinent inquiry: What has been his experience? What was his education on this subject? With what companies has he been engaged? What work has he done to which he can point with pride as a specimen of careful work? Is not this the same Mr. Brown of the "Brown Converter," who endeavored strenuously for two or three years to convince the various arc light companies of the country that it would be a great benefit to the public at large, and to their dividends (for which he now expresses such a lordly contempt) to carry a 3,000 volt current for incandescent lighting, into houses and stores by means of an apparatus of his own devising, and which was designed to occupy the very field now taken by the alternating current system? It is curious that he should apply to the alternating current system the very expression which was applied to it by one of the salesmen who was trying to induce me to adopt the "Brown converter" for house lighting on arc circuits, that "this damnable alternating current system is just wiping out apparatus like ours all over the country." Can it be possible that a distinguished electrical engineer, like Mr. Brown, could allow himself to be swayed by any such trifle as this? Let us trust not. Yours truly,

T. CARPENTER SMITH.

COMMUNICATION FROM S. C. PECK.

The Honorable the Board of Electrical Control:

NEW YORK, July 12.—In the New York *Evening Post* of June 5th, there appeared an article by one Harold P. Brown, electrical engineer, upon the dangers to be expected from electric lighting apparatus. This I have read, and carefully noted his suggestions to your board regarding certain precautions which he claims should be observed. It appears to me that the article is hardly written in a fair spirit and that many of the comparisons are obviously unjust and incorrect, and the suggestions impracticable.

In the first place the current from open coil armatures is referred to as "pulsating" and "death dealing" and is described as being much more fatal to human life than the

current from a dynamo having a closed coil armature. It seems to me that this is purely and simply a matter of conjecture on the part of Mr. Brown.

I have tried many times to distinguish between the physiological effects of this so called pulsating current and those caused from a closed armature. I have used in all cases sufficient resistance in the main line to give a difference of potential of from 60 to 200 volts. The sensation experienced in each case is precisely the same, as indeed is the effect upon the needle of a delicate galvanometer, which will stand perfectly still when under the influence of a current of either character from a properly constructed machine. No doubt but a voltage of 2,500 would fatally injure any person introduced into the circuit, but the idea that the effect of the open coil armature current would be many times that of the closed coil would be merely guess work, for I do not consider we have any reliable data to work from.

Assuming there have been more unfortunate accidents upon circuits operated by dynamos of open coil class, what do they prove? It is well known that these dynamos can carry more lights and consequently a higher potential than the other style and who can say that Mr. A and Mr. B would have lived had a shock of the same voltage come from a dynamo of another type? One thing is certain, viz: That there have been fewer fatalities resulting from the electrical current than from steam or other motive power. It is stated that but five men have been killed in New York during the past ten years.

Mr. Brown compares the alternating current as produced by dynamos, with that emanating from what is generally known as the medical coil. He, as an electrical engineer, should know that they are in no manner similar except that they both are bi-direction currents. In the first place the current of the ordinary medical coil capable of throwing a spark one-sixteenth of an inch in length is immensely greater in pressure than that of the 1,000 volt generators now in use which are incapable of striking through an air space of even one-hundredth of an inch; and, again, the current in a medical coil is produced by a direct current being made and broken, inducing currents of tremendous pressure, of but little volume in the secondary. The unpleasant feeling caused by this current is directly traceable to what is known as the extra current, caused by the rapid changes in quality of the magnetization of a core of iron upon which the coil is wound as well as the self-inductive effect of the coil itself.

With the alternating current the case is materially changed. A very small amount of wire is revolved in the field of force which is absolutely constant and is not affected in the least by changes in the external circuit. The amount of potential is predetermined and controllable. There is no self-induction of any moment, to produce the dreaded extra current; and opening the circuit, or introducing one's self into it, merely subjects one to the pressure of 1,000 volts which has never yet proved fatal. There is no extra current and no kick from the field magnets.

But in supplying incandescent lights from alternating current circuits, it is not customary, for many reasons to introduce the high pressure wires into the interior of buildings. Between the primary circuit and the house circuit a transformer is interposed which effectually changes the character of the current from one of 1,000 volts pressure to one operating but 50 volts.

Mr. Brown states that there is but a thin film of cotton or silk between the primary and secondary windings of the transformer, and that this is liable at any time to be ruptured by a flash of lightning. This shows that he is totally ignorant of the construction of alternating current apparatus as well as the method of installation adopted by the leading persons in the business.

I am familiar with various methods of protection used, and have no hesitation in stating that when such as I shall describe, which have been adopted by the Thomson-Houston Electric company are carried out, there is no possibility of high potential affecting persons through any accidental contact with the secondary wires. In the first place, this company operates its dynamos at a potential of but 1,000 volts, as against 1,800 or 2,500 used, and so far, with safety, for the past two years in many places abroad. For every installation of transformers a lightning arrester is used which is absolute in its action and effectually prevents any ill effects to the transformer from a lightning stroke upon the line. I have never known one to fail yet. Then the primary winding is separated from the secondary by a very substantial septum of insulating material thoroughly dried and shellaced, and finally, the secondary or interior circuit is soundly connected to the earth. Where is there any danger now? Even if the high potential were to get upon the secondary line, what possible harm could be done? Suppose the primary line in a first class condition and the secondary properly grounded as described, also the accidental contact upon the primary and secondary. A person touching the secondary, and at the same time making contact with earth, would be affected in what manner? Not at all. Why? Because there is no complete circuit. But go further and suppose a ground upon the primary as well. A person touches the secondary and again there is no effect. Why? Because there is a complete shunt about his body caused by the earth and the ground connections, and even if the transformer were not instantly cut out of the circuit, all the current would go by a shunt which is of no resistance and would not influence the man at all. Why should Mr. Brown be so set against the high tension alternate current when it has been in successful operation for so long a time, and which even under the worst conditions could but introduce a potential of 1,000 volts upon a few lamps at a time? It is not consistent, because we find about a year ago a description of "the Brown automatic converter," a modification of a device to be used in running incandescent lights from arc current circuits, "without involving a large expense for incandescent lighting plants, or the necessity of getting a large number of subscribers to commence with and also valuable to incandescent lighting companies for customers too distant for the ordinary incandescent circuits."

Why are no charges made here against incandescent circuits which must be considered extraordinary? Surely no man so careful for the safety of a general public would advise the use of such an arrangement which is liable at any time to bring a difference of potential as high as 3,000 volts into a man's house, and this pressure too of a dynamo producing a "deadly pulsating" current, for we have read in the advertisement in capitals "Can be Used with any Make of Arc Light Dynamo." To say the least it looks very curious and one is inclined to read between the lines when noting an "electrical engineer" stand forth in commendation of the one successful, commercial method of introducing the electric incandescent light and stating that the use of 300 volts of alternating current is dangerous, but implying the operation of incandescent lights upon 3,000 volt current circuits is not to be condemned when in conjunction with the converter. Let us take up his letter again and turn to the suggestions. In order to discover the presence of a ground upon the line, he advises the use of a permanent ground connection at the station.

Inquire among station superintendents and see how many of them agree with him. In order to keep a line in condition we are told to subject it to a constant strain at every insulator and contact point. Is this wiser than the present method pursued by all properly governed companies? viz: To test the circuits every day and to keep them free from ground. Also to shut down should any vicious connection occur during the night? There is a station in this city which is constructed on sound principles. The wires are well insulated and well run, and there has not been a ground on a circuit for weeks.

Again, we are told that to prevent the flow of the extra current through the body of a person introduced into the circuit, we are to place a voltmeter or high resistance about the dynamo terminals. Very well, do so, and what will you have? Evidently the resistance must be high in order that too much current may not be going to waste; now will not the "death stroke" divide itself according to the law of shunts, and will the person get a good share? If the resistance were constructed as a coil I am not sure but its effects would be practically useless and until it is definitely known whether it is the prime potential or the after current which kills, we had better pay more attention to the exterior lines and construction and less to such traps.

And again, we are to provide a means for automatically shunting the fields when the external circuit is opened. There is more merit in this than in the other schemes, but I do not believe any device could be made sufficiently sensitive to operate in time to prevent any person opening the circuit, and at the same time not to interfere at improper moments.

As there are so many simple and effective methods for determining when the circuit is broken, it does not seem wise to make any such law.

The reference to the Siemens company is not bad. It has been published in several papers in New York and Boston, and always in the same words. Investigation shows that the company referred to never did make a business of manufacturing alternating apparatus other than a dynamo which is to-day made by them and for sale in Europe. Perhaps the reasons they did not manufacture can be found in the records of the Patent office, or may be Rankin Kennedy's articles on alternating current apparatus would prove of assistance to those desiring a partial idea of the true state of affairs abroad. The position of Chicago and its inspector is well-known.

We read last that the "damnable" alternating current should not be permitted in higher voltage than 300, and that if the proposed rules are adopted three men shall not have died in vain. It can only be said that most of the rules, as well as the letter show under a philanthropic exterior a distinct bias, which, perhaps, may be accounted for when we recall Mr. Brown's connection with the American company whose dynamo has a closed coil armature. It would be interesting to read the opinions expressed by Mr. Brown when he was engaged in installing the plant of the Brush open coil system in Eau Claire, Wis.

A summary of Mr. Brown's paper may be made as follows: First, the alleged comparison between the effects from a medical or galvano-faradic coil and the alternating current dynamo does not exist; second, the death dealing quality of the current from dynamos having open coil armatures is but conjecture; third placing a shunt of high resistance about the terminals of the dynamo is impracticable and would but partially compensate for the after or extra current; fourth, it is not clear that death is caused by the after current or "kick" of the machine. In fact, it is probable that such extra current is not essential from the fact that fatality has occurred from simple connection with a grounded wire; fifth, a constant ground on a high tension dynamo in order to detect a second one is poor engineering; sixth, a break in the circuit would be indicated by the performance of the apparatus in the station, and the one in charge should shut down without any further notice from a complicated device which might render steady commercial service questionable; seventh, under no circumstances should 300 volts be made the limit allowed alternating current service, because practical demonstration extending over a period of two years, shows that where the proper protecting devices are used there is no danger.

In conclusion the writer must suggest that in the action already taken by your board regarding overhead construction, is to be found the solution of the danger question.

Of course, the electric current under certain conditions is dangerous, but no more so than steam plants or various forms of motive power. What is needed is control and not prohibition. Look over the lines last constructed in your city and note that any danger from them must be preceded by some accident not traceable to the installation or operation of the plant. A stone upon a rail may wreck a train. A boiler under 150 pounds, steam is subjected to greater strain than one with 50 pounds but by strengthening the construction we keep the steam in. Follow rule number 2 suggested by Mr. Brown and let us use better insulated wires. Whether it be Cowles, or Simplex, Trinidad or Bishop's makes little difference, but keep up the standard. The extra first cost of an installation even with the most expensive wire will not average more than 5 per cent. on the total investment, while the percentage of improvement in dividend paying quality is not to be estimated.

Respectfully submitted,

S. C. Peck.

Communication from M. M. M. Slattery:

The Honorable Board of Electrical Control, New York City:

Fort Wayne, Ind., June 29.—The question of the danger of alternating currents in the present systems of lighting by incandescent lamps has been in the past a much-discussed one, both at the meetings of the National Electric Light Association as well as at the meetings of various scientific societies through the country, and the conclusions arrived at by those who are theoretically and practically competent to judge are that the alternating current is not dangerous by any means when used within certain limits of pressure, and that the safety limit approximates 1,100 volts electromotive force. After an extended practical experience of three years by those who have carefully followed the alternating systems in use, and after many physiological experiments, frequently involuntary ones, to determine the safe limit of pressure to work with, it has been found that no fatality can occur or serious inconvenience result from a shock from an alternating current having a pressure of that already cited, 1,100 volts. It has been long and well known that in most cases where fatal accidents have happened with high tension continuous current systems the death shock is received at the moment of breaking away from the circuit, not at the moment of completing the circuit around the body; the reason is obvious and two-fold, viz.: When you place yourself in a circuit in which there is flowing current at a dangerous pressure, the skin of the body, which has a very poor conductivity, in fact has good insulating properties, partly protects you from the danger shock, but as you will involuntarily make a desperate attempt to throw yourself out of circuit and succeed, at the moment of breaking away an arc will be set up, burning the body insulation (the skin) and freely entering the trunk, cause paralysis of the respiratory organs, preventing thereby the blood from being oxidized; death will then ensue unless instant remedies be applied, and right in the latter line recently in France the passage of an alternating current through the body has been very efficacious in restoring life. The other reason of the fatality referred to is, at the moment of breaking circuit, an electromotive force far higher than was normally in the circuit is developed, considerably aggravating the effect of the shock.

In an alternating current of the same dangerous pressure there will always be a much better chance of escaping a fatality than in the case just quoted, as in the first place the electrical impulses being equal and opposite, the effect of the normal electromotive force alone will be experienced, for at the moment of breaking away from the circuit when the pressure would have a tendency to rise an impulse in the opposite direction will instantly neutralize it and the e. m. f. is maintained normal; again the very nature of the current with the impulses equal and opposite also tends to suppress the arc at the moment of breaking, for the self same reason as that which tends to maintain the e. m. f. normal, preventing the skin from being so badly burnt, and the current proportionately from free and dangerous passage to the vital organs.

The danger attending the use of converters has been referred to, chiefly, however, by those not familiar with their construction. We will admit for the sake of argument, that we have exceeded the safe limit of pressure in the converter, and let us see whether the dangerous current will or will not reach the users of the incandescent lamps.

I will premise what I shall say at this point by stating, and I have occasion to say so elsewhere, that two-thirds the difficulty is overcome when you understand its nature. Now in this case we want to prevent the dangerous current reaching the users of lamps. We know the current is dangerous, our practical experience has so informed us. The secondary coil in the circuit in which the incandescent lamps are placed is in the same iron receptacle as the dangerous primary coil which is connected with the primary circuit and by the entrance of moisture or a discharge of lightning the organic insulation between the two coils might very readily give way as it occasionally did in the earlier experimental stages of the work years ago. We should not, however, trust to any insulation to keep the current in the respective coils; in this case we simply introduce a conducting strip of copper or other metal between the primary and secondary coils in the box containing the converter, this strip being carefully insulated from both primary and secondary coils as may be seen in the converter submitted for inspection.

Now what is the effect of the dangerous primary current endeavoring to reach the secondary coil and circuit? It will be obvious that it will be intercepted by the interposed metallic strip referred to and the current which might enter the secondary is diverted to a ground connection made with this strip. Should a lightning discharge enter the primary it will surely go to ground, for which it has in all cases an affinity seeking the passage of lowest resistance. Should a lightning discharge strike the house and the secondary circuit, and make an attempt to get on the line through the primary, again it is intercepted by the metallic strip and the integrity of the insulation between the primary and the secondary is maintained, no harm happening.

These precautions have been dictated by experience in the induction apparatus, and I may be forgiven when I say that any other difficulty which may present itself as time rolls on and the alternating systems develop in magnitude will be equally carefully and successfully met.

As an instance of the unmeaning glibness of the speech of some of those who desire to constitute themselves authority on the subject, but who have never qualified in any practical form, speaking of the dangers attending the use of the alternating current, in the New York *Evening Post*

of June 5th, a gentleman states that the danger attending the use of alternating currents will not be decreased, but contrarily will be greatly increased by placing the conductors underground. It is evident that the gentleman has concluded that because with the underground low tension continuous system great difficulty has been experienced in properly insulating to prevent troublesome grounds and disastrous leakages, that all other systems as a matter of course suffer similarly. In point of fact the low tension current at 220 volts in underground conductors offers a far greater strain upon insulation than a high tension alternating current at 1,100 volts. It will be known that one of the functions of a current flowing through a conductor is a heating one, that the greater the current transmitted through a given conductor the greater the heat, or in other words, the heat developed is as the current squared into the resistance, C^2xR. It will further be known that with slow radiation as must necessarily be the case with conductors underground, the heating effect with a given current and cross section of wire must be enormously increased. With low tension continuous current systems it frequently happens during the hours of heaviest lighting that a loss of some 20 to 25 per cent. is incurred in the conductors, and any person familiar with the temperature that a conductor attains at such a loss as this will not wonder at the trouble of the low tension system and the consequent strain on the insulation. On the other hand, with the alternating current no such loss in the conductors need ever be permitted; throughout the hours of use it may therefore be comparatively cool, certainly never warm enough to prejudicially affect the insulation. The reason of being able to work at a low temperature in the latter case of course is that working with a current alternating in polarity, small in quantity and high in tension, we can afford to work at a much less waste of energy and corresponding reduction of temperature in the conductors; therefore, the insulation of the wires in the latter case need never be strained, the strain on the insulation by the use of the higher e. m. f. being more apparent than real. These conclusions have been arrived at by careful practical experiments that no amount of sophistical theorizing can refute and are equally within the scope of all who wish to familiarize themselves with a few elementary facts.

By the use of the alternating current as now employed by companies long in the field, who have a reputation at stake, the electrical engineer has placed in his hands an electrical lever, so to speak, with which he may move the world, practically the greatest of all electrical developments of the age, of incalculable value and far reaching possibilities, and any objections to its use (and their name will be legion) by interested persons, should be regarded and dealt with carefully and impartially as affecting something of immense public value as well as something of future public value that at present it is impossible to overestimate and should not be too hastily condemned in consequence by the utterances of the inexperienced. Yours very truly,

MARMADUKE M. M. SLATTERY, FORT WAYNE JENNEY ELECTRIC LIGHT CO.

COMMUNICATION FROM RALPH W. POPE.

Hon. Theodore Moss, Secretary Board of Electrical Control, New York city:

NEW YORK, 30 Temple Court, July 9.—I have the honor to acknowledge the receipt of a copy of the minutes of the proceedings of the board, dated June 8th, containing a resolution in which my opinion is requested, regarding certain suggestions as to the amendment of the rules of the board, proposed through the public press by Harold P. Brown, which are as follows:

"RULES FOR STATION LIGHTING.

"1.—Not more than fifty arc lights shall be operated upon any one circuit, unless said circuit is used exclusively for street lamps mounted upon wooden poles; in this case the number must not exceed sixty,

"2.—All out door arc light circuits must be provided with waterproof covering having an insulation resistance of not less than one-half a megohm. Any circuit falling below this must not be used until restored.

"3.—No arc light dynamo shall be operated unless provided with a voltmeter across its terminals, or other device, to provide a path for the extra current caused by the opening of the external circuit.

"4.—No arc light dynamo shall be operated unless provided with means for automatically stopping the production of current the instant a ground connection is made upon its circuit.

"5.—No arc light dynamo shall be operated unless provided with a means for automatically breaking or short-circuiting the field circuit the instant the external circuit is broken, in order to prevent a current from being built up by the broken circuit ends falling upon some conductor.

"6.—No alternating current with a higher electromotive force than three hundred volts shall be used."

I have also read the communication of Mr. Brown accompanying the proposed amendments. It has been my privilege to attend a large proportion of the meetings of the board, and I believe that I thoroughly understand its desires in the premises, which are in the main, to bring about a reform in the existing condition of electrical conductors in this city, without interfering with the business interests of their owners or depriving our citizens of the many benefits accruing from the various systems which depend upon electricity for their successful operation.

One of the greatest difficulties encountered in the proper regulation of electrical service prevails in other branches of modern industry, where the danger to life is outweighed by the desire to increase financial gain. These facts are so generally recognized that I refer to them merely as a reason why it is proper that every precaution which science can devise should be utilized for the protection of human life. The rules in question appear to have been framed with this object in view, and so far as they are confined to this praiseworthy object, they meet with my unqualified approval.

It is now the generally accepted opinion among scientific investigators, many of whom have had ample experience upon which to base their reasoning, that there is a wide range of difference between various persons as to their power of enduring the effect of an electric shock. The same person may also be much more susceptible to its influence under certain conditions of the body, as for instance when the skin is moist from any cause. A person unaccustomed to the peculiar sensations caused by the passage through his system of an electric current, if of a sensitive nature, may suffer from fright. Indeed, the mere spectacle of a thunder storm where the chances of personal injury from lightning are infinitesimal, may produce serious results. It will therefore be understood that it is extremely difficult, if not impossible, to fix upon an arbitrary standard which an electrical current must not be permitted to exceed, for the reason that many useful classes of service may thus be entirely prohibited without any substantial reason. All forms of electricity as used in the various systems with which we are familiar, are entirely controlable, with the exercise of such skill and experience as now exist. No form of current is used which with the exercise of proper precautions cannot be confined to its legitimate path and it is in this direction that it appears to me that our efforts should be directed. When with the introduction of every known precaution it is found impossible to so confine an electric current to its proper channel it will be time enough to prohibit it by statute. The very fact that many of the companies now doing business have not exercised that precaution which the interests of the public demand is the reason for the existence of the Board of Electrical Control. In view of the prevailing opinion upon the importance of so constructing and operating an electrical plant of any description, it appears to me that any company or individual proposing to establish an industry of this character, at this date, must be well aware of the importance of complying with such rules as are established by the proper authorities acting in the interests of the public.

The pith of the line of policy to be pursued in my opinion therefore would be, not to fix upon any particular number of lamps to be operated on one circuit or any standard of voltage which must not be exceeded, but rather to insist on such methods of construction and the use of such material, that the current will be confined to its designated conductor. This implies the use of a conductor of ample size for the current to be used, and properly insulated at all points, the insulation resistance increasing in a proper ratio to the increase of voltage.

If we aim constantly in this direction, I believe we shall eventually attain the end we all have in view, which is the greatest possible extension of the benefits to be derived from the more general use of electrical devices, without danger either to life or property, even where the various fixtures and appurtenances are necessarily within the reach of persons not familiar by training with the mysterious dangers which are supposed to lurk in every electric wire.

I would therefore respectfully suggest that the first and last of the proposed rules be stricken out, and that the second rule be more fully elaborated.

In view of the fact that with the best possible methods of construction accidents are liable to happen rendering an otherwise perfect system defective, I should recommend the adoption of the precautionary rules numbers 3, 4 and 5, provided there be no existing practical reasons why they should not be enforced, as I am not in favor of the adoption of any regulations of such a character that they must necessarily remain a dead letter. Yours very truly,

RALPH W. POPE, Consulting Electrical Engineer.

COMMUNICATION FROM PROFESSOR HENRY MORTON.

The Board of Electrical Control:

HOBOKEN, N. J., July 16.—In response to a letter from Theodore Moss, dated June 20th, inviting me to express my views on the subject discussed by H. P. Brown in a letter to the *Evening Post* bearing date June 5, 1888, I would say that I quite agree with Mr. Brown in his opinion that in all cases mentioned by him in which death has been caused by coming in contact with electric wires the accidents would have occurred, just the same, if the wires had been buried underground, or to use his own words, "I know that burying the wires would not remedy the trouble." I would, however, go further than this and say that in the instances he cites and in all others known to me the accident which occurred would have been more likely to occur or more certainly fatal if the wires had been buried underground in any arrangement which has as yet been provided for that purpose, and this chiefly for the following reasons: The buried wires, as experience has abundantly shown, are in constant danger of making earth connections which render a contact with only one point fatal where it would be otherwise harmless. Even the Edison wires in New York are frequently being torn up to repair injuries due to loss of insulation, notwithstanding their very low electromotive force, of but 110 volts, as any one can see who has occasion to go about the streets traversed by the Edison conductors down town. When currents of twenty times this electric pressure, as it has been aptly called, are used this tendency to rupture the insulation is proportionately increased and has proved practically fatal to any commercial success in using such currents through underground conductors. Those persons who have been killed by touching lamps or single wires have been killed only because there was some earth connection already established elsewhere on the circuit. Again, in the instances where employes of the electric companies have been killed while employed in connecting or otherwise working with wires carrying currents, it is manifest to any one that the danger would be greatly enhanced if their work was to be done in dark and narrow manholes in place of in broad daylight and in free space. The cry of the public as represented by the daily press to put the wires underground as a remedy to all dangers and difficulties is not an intelligent cry, but on the contrary is the result of ignorance and misdirected prejudice.

In the next place Mr. Brown points out at some length the difference between a continuous uniform and a pulsating or alternating current, but in this connection I think that he has rather mixed up and confused several different things.

The intense effects produced by an induction coil such as is used for giving shocks and in medical treatment is not the result of its interrupted character, but of the peculiar arrangement of magnetic core and coils of wire by which the electromotive force of the interrupted secondary current produced is raised to a point fully equal to that of the longest circuit ever employed in an arc light system. In other words, the electric pressure obtained in a medical coil is fully equal to that in an arc light circuit carrying 50 lights. It is also alternating, and therefore as far as these conditions are concerned, should be certainly fatal. Such, however, as every one knows, is not the case. I, myself, once received the discharge of such a coil capable of giving sparks twenty-one inches long, and therefore equal in electric pressure to hundreds of arc light dynamos united for that purpose, and the sensation was no worse than the shock from a Leyden jar of moderate size. It is manifest therefore that the interrupted or alternating character of the current even when combined with the highest electric pressure, is not its esssentially fatal condition. The actual facts seem to be these, as far as we can gather from the fortunately very limited number of accidents fatal or otherwise which have occurred.

There are two ways in which the electric current can derange the living structure:

1st. By mechanical and chemical injury to the organic structure.

2d. By nervous exhaustion or nervous shock. The first of these requires the passage of a considerable volume of current with enough electromotive force to carry it through the resistance of the body. These conditions are fulfilled by a continuous or uniform current of high electromotive force, and are not found in the same degree in an alternating or interrupted current. The second method of injury, or that by nervous shock, requires chiefly the interruption or reversal of the current, but this nervous influence only becomes dangerous when long continued or combined with the other influence of large current volume. Experience, however, shows that the interrupted current loses as much in the direction of fatal effect from organic destruction as it gains from its superior nerve exhausting power, so that quite as many have escaped without fatal consequence from an alternating current as from a continuous one. Either may be fatal, but neither has any known superiority over the other in this respect, and there is certainly nothing in the results of experience or observation so far which would warrant us in requiring less precaution in the use of one sort of current as compared with the other or in excluding one where the other was admitted.

Mr. Brown states, as of his own knowledge, "scores killed and maimed by the pulsating currents." In regard to this I can only say that I have no such information either direct or derived and would be very much interested in investigating these scores of cases, if Mr. Brown would give some specific reference to them.

I quite agree with Mr. Brown as to the imperfections of the underwriters' wire. This wire was passed or allowed by the underwriters many years since when it was the best and only wire available for the purpose; but they have since "approved" many other wires with superior insulation which have just as much claim to be called "underwriters' wire" as the first and inferior kind.

What Mr. Brown says about the universal condemnation of the alternating system by disinterested electricians of high standing must be founded upon a very limited knowledge of the subject. The only authority he cites is that of Siemens & Halske who are known to everybody as manufacturers of and dealers in dynamos, electric lamps, etc., patented by themselves, and authors of a pamphlet or trade circular attacking the rival system of electric lighting by secondary currents with so manifest a bias as to deprive what they say of any weight whatever. I can hardly believe that Mr. Brown can have seen this publication, but must speak from some incorrect report of its contents.

Without taking up more of your time, however, with a discussion of Mr. Brown's preamble, I will at once pass to his proposed rules.

Rule 1st, proposes limiting arc circuits to 50 or 60 lamps each. This would be a very unscientific and unfair method, as it would allow some companies to run circuits of twice the electromotive force or pressure of others. Thus 50 Brush lamps would require an electromotive force of 2,500 volts, while 50 United States Electric Lighting company lamps would require but 1,500 volts. The rule should be founded on some accurate standard of measurement, and not be like the weight standards of the early Dutch settlers described in Knickerbocker.

Rule 2d, providing for insulation of wires as stated is utterly indefinite and meaningless. Under it a naked copper wire might comply with the requirements and the Atlantic cable might fail to do both within reasonable constructions of the rule as stated.

Rule 3d, providing for a cross circuit of high resistance near the dynamos, is also indefinite and unnecessary, but would do no harm.

Rules 4th and 5th, providing automatic means of shutting off dynamos on the grounding or breaking of their circuits are good, but are already carried out in most electric lighting systems.

Rule 6th, excluding the use of alternating currents of high electromotive force is unwarranted and absurd.

If more time was at my disposal I could enlighten your commission on many other points connected with this subject, but believe that I have said enough already to discharge my duty as a good citizen in a matter in which I have no direct concern. Very truly yours,

HENRY MORTON,
President STEVENS' INSTITUTE OF TECHNOLOGY.

(To be continued.)

The Edison Electric Light company of Rochester, has received the contract for lighting the city hall in that city at ing the rate of $1,700 per year.

Okonite Conductors.

The London *Electrical Review* in a lengthy article treating of okonite conductors, says:

Professor E. Frankland, in forwarding the results of his experimental examinations, remarks: "These tests have convinced me that the material possesses, in a very high degree, all the qualities which render it valuable for electrical purposes. The resistance to leakage is extremely high, and the cables themselves are not easily injured by rough treatment." George Hamilton, chief electrician of the Western Union Telegraph company, gives a large number of tests of okonite core supplied to his company, and remarks: "I would say that having tested 300 miles or more of the okonite core, and finding it so uniformly good, I have learned to have a very high appreciation of it." In a subsequent report he says: "The Western Union company has quite a large amount of the core in service, giving the best satisfaction. The insulation of the core is exceptionally good, and so far as my experience goes, is not surpassed for aerial or underground work." The fact that a large quantity, amounting to some hundreds of miles, has been used by the Western Union company, is sufficient proof of the excellence of the material. As regards the electrical and mechanical properties of okonite, an exhaustive report by Dr. John Hopkinson, F.R.S., gives some information. The specific inductive capacity of the material is found to be 4.6, slightly higher than the usual value given for gutta percha. The insulation resistance of the several samples was uniformly high, and tests taken at various temperatures showed that it was affected in a greater degree than ordinary rubber. For instance, the tests of the sample gave at 60 deg. F. 7,587 megohms per statute mile; at 75 deg. F. 3,810 megohms per statute mile, figures which correspond nearly with the coefficients given in the company's own table for the effects of temperature. Numerous tests were also applied by Dr. John Hopkinson to see if mechanical distortion and distension had any effect on the insulation, but no deterioration ensued. Dr. Hopkinson in his report remarks: "It has of course, been impossible to ascertain the durability of the insulation when exposed for a long time to the air. The tests for insulation and capacity were made upon three samples, each about 2,000 feet in length, and one sample of 300 feet in length. The only test which has been made to ascertain whether the contact of foreign substances has any deleterious effect on the insulation, is the following: Ten feet from B coil were immersed in colza oil for four days, exposed to the air for one day, and then tested; the average rate of loss during five minutes was .00035 per second, corresponding to insulation resistance of 8,386 megohms per mile, proving that the material had in no way suffered." The tests given by Dr. Hopkinson are remarkably good, but the results obtained by him are best given in his own words: "Summary.—Shortly, my tests on these samples of Mr. Smith's insulated conductors prove that the insulation is practically perfect, both for high and low potentials; it is at least equal to the best G. P., and that the insulation will stand very rough handling, and a considerable temperature without injury, indeed, with a quite insignificant reduction of the insulation resistance." In a later communication from Mr. Hamilton of the Western Union company, he remarks: "My experience with the okonite core, for something over two years, has been very satisfactory. I have yet to learn of the first case of deterioration of the core that has passed under my inspection, although in amount, it figures up several hundred miles, and is used in both aerial and underground cables." It is claimed for this core that the "tenacity and toughness of the material render it non-liable to destruction by reason of abrasion or rubbing of foreign substances." We have ourselves tested samples of this core mechanically, in a variety of ways, and also under the application of heat, and find that it fulfills all the conditions guaranteed by the makers. While resilient it is remarkably tenacious, and its strength and toughness are very great; the wires are uniformly well covered, and its durable qualities may be taken, from all the evidence we can obtain, to be very great. It is not attacked by acids, and greasy substances do not affect it. We have only noticed that paraffine oil has a remarkable action upon the material. In the samples we have tested, the copper not being tinned shows the effect of vulcanizing, but in a much less degree than in ordinary vulcanized cores. For ordinary telephone work we think that the inductive capacity and the amount of covering required are rather against the adoption of okonite, but for general telegraph work, especially for "leading-in" at stations, signal boxes, etc., this core will be especially valuable. Its mechanical properties, high insulation, and indifference to heat, render it a very efficient core for electric light purposes, and we should not be surprised to see it used largely for such positions and places where most insulated wires have hitherto proved failures.

Personal Paragraphs.

Francis W. Parker, electrical patent lawyer of Chicago, will leave for Europe August 5th, on a trip connecting business with pleasure.

J. B. Thomas, of the Westinghouse company, sailed for Europe on the Etruria July 5th. He is on his way to Italy to establish agencies for the Westinghouse company. Several machines were sent to that country several weeks ago, and Mr. Thomas goes there to superintend their installation and establish electric light plants. Rome and Turin will be his principal objective points, and he will probably be away for several months.

A Parkersburg, W. Va., dispatch dated July 18th, says: United States Circuit Judge Jackson this evening decided the case of the Bell Telephone company against the Exner Telephone company of Charlestown, perpetually enjoining the latter from operating their telephones and decreeing the surrender of all instruments and outfits to the Bell company. The case has been in court several years. B. G. Washington is president of the company.

CORRESPONDENCE.

From St. Louis, Mo.

St. Louis, Mo., July 20.—William Jens, engineer of the Scullin street car lines, is home from a month's trip in the east, in the course of which he examined every electric and new street car motor to be found, for Mr. Scullin is determined to have some motor soon and to have the best and most modern, so that he will not be compelled to make a change again within a few years. Mr. Scullin himself prefers the electric motor if it can be made thoroughly practicable, as to cost and service, and so does Mr. Jens. The latter, however, inclines toward the overhead wires while Mr. Scullin prefers the storage battery, if for no other reason than the objection to overhead wires and the probability of trouble in securing the privilege of stringing them in St. Louis. Mr. Jens was completely won over to the wire system by the operation of the road at Richmond, Va., where twenty-five to thirty cars are employed steadily, running as smoothly as they could possibly run by any other motor. He thinks very favorably, however, of the progress of the storage battery toward perfection, and anticipates a successful experiment with the car now being constructed at the Wharton works in Philadelphia. This car was to have been here sometime ago, but Mr. Wharton has changed the plan from a four to a two-truck car, on the theory that the car might be inclined to jump the track on the granite paving, and would be difficult to run on again if it was of the four-truck size. He now promises the car for August 15th, intending to fully test it on the streets of Philadelphia before he allows it to be shipped west. The car will be sixteen feet long, elegantly upholstered and lighted with incandescent lamps. It will be propelled by two Reckenzaun electric motors of eight horse power each, capable if need be, to work at fifteen horse power. The car can be run a distance of sixty-three miles with but one change of the storage cells, 100 of which are placed under the seats of the car, but in daily service it is better not to exact more than forty miles, while the best way is to make a change of cells, which can be accomplished in two minutes, three times a day. The motor is provided with worm gearing. The weight of all the electrical apparatus and machinery is 5,800 pounds and that of the car 9,200 pounds, a total of 15,000 pounds. A speed of twenty miles an hour is possible, but the car will give the most efficient service at about eight miles an hour. A 50 candle power incandescent light, the rays of which are intensified by a reflector, will be in position as a headlight. The brake, which is a powerful and efficient one, operates on all eight wheels of the car at once, speedily checking its motion. In the event of accident to the brake there is an electrical arrangement by which the car can be brought to an almost instant standstill. The electrical gong, which sounds a warning, the throwing off of the brake and the manipulation of the sand-box, are all worked by a pressure of the foot of the driver upon different levers, which are within easy reach on the platform, thus doing away with the necessity of his taking his eyes from off the road in front of him. The cells in which the electric current is stored are of the type known as "23 C" of the Electrical Accumulator company's make. Mr. Jens made several trips on one of these cars, a four-truck, 22 feet long, and was perfectly satisfied with its operations. A.

St. Louis, Mo., July 20.—The Menard Jacard Jewelry company have decided upon the Edison system for use in their new store, at the corner of Fifth and Locust streets. The plant will consist of an Edison dynamo capable of running 210 25-candle lamps, and a Russell engine.

The Mercantile Library association have canceled their order for one engine and one 30-light arc dynamo, owing to an injunction being served on them restraining them from doing a general electric light business. As the matter stands at present, the plant will consist of two 30 light arc dynamos, two 450 light Edison dynamos, and two 75-horse power Russell engines.

The Woodward & Tiernan Printing company will put in a Russell engine to drive their Edison plant.

The Pike Electric company have secured the contract of furnishing the Quick Meal Stove company a 200-light plant. The plant will consist of a Fremont dynamo and lamps, and will be placed in the new building on Chouteau avenue.

The $20,000 bond of the St. Louis Electric Light & Power company was approved by the House of Delegates last week.

The water commissioner received but two bids for lighting the water works and surrounding streets. The Fort Wayne Jenney were the lowest bidders, but were above the appropriation. The commissioner will make out new specifications and advertise again.

A bill has come up in the house for its first reading, authorizing the board of public improvements to advertise for bids for lighting the city north of Cherokee street. This will embrace four-fifths of the entire city, and will require over 1,000 lights.

The 50-light incandescent machine installed in the new building of the Dr Harter Medicine company by G. J. Percival, is giving splendid satisfaction

The Heisler company have secured the contract of furnishing the exposition with 600 30-candle power incandescent lights. The exposition is wired for 4,000 lights, but has a dynamo capacity for but 3,000.

The American Express company are having their building wired for incandescent lights, by J. F. Porter. Mr. Porter reports business good. B.

New York Notes.

New York, July 19.—The Brooklyn street car companies have under consideration the adoption of an electric fare register, by which a fare will be rung up whenever a passenger places his foot on the step of the car. There seem to be, however, numerous practical objections to a device of this kind, and it will doubtless require many modifications before it comes into general use.

Ex-Governor Alonzo B. Cornell is now largely interested in the tin deposits of the Black Hills, and is also developing a valuable quarry in the Catskills, containing sandstone, granite, and black marble in large quantities. There is also a very handsome stone containing shells, which polishes beautifully. It is said that the governor has been very lucky ever since his investment in the blind pool some years ago.

William Maier, who had charge of the electric lamps at the Adams Express building in this city, was found dead in the dynamo room, Monday afternoon. His body was stretched on the floor between two dynamos which were running. The autopsy was held the following morning when it was decided that he died from the effects of an electric shock although it was impossible to determine just how the accident occurred. This is the second death that has been caused by electricity on these premises.

The department of public works and the bureau of incumbrances, through Inspector McGuinness, yesterday began anew under the advice of the corporation counsel, the work of finding out whether the dead poles are dead, and whether they can be removed without the order of the mayor, as live ones cannot be.

The Standard Underground Cable company, through George L. Wiley, eastern manager, has contracted with the Brush Illuminating company of New York, to furnish and lay in the underground conduit from Fourteenth street to Thirty fifth street, in Broadway, an eight-conductor arc light cable. The conductors are to be of number 4 Brown & Sharpe gauge, each covered with the Waring insulation, and the whole cable incased in lead. The cable has been gauranteed for a term of years, and a sample of it submitted to the electrical expert of the Board of Electrical Control for approval. P.

Indianapolis Items.

Indianapolis, July 21.—The Jenney Electric company report having received, during the last week, an order from Sullivan, Ind., for a 60 arc light outfit complete, also for a 60 arc light addition, including engine boiler, for Topeka, Kansas. They also have an additional order for 40 arc lights from Stockton, Cal.

A. S. Hickley, chemist and expert of the Jenney Electric company, has succeeded in producing photographs of the moon, seven inches in diameter. They are said to be the best photographs of the size that have been produced.

The injunction suit of the city against the Citizens Street Railway company to prevent their laying their track on Alabama and Market streets, was decided in favor of the Citizens' Electric Railway company by the Superior court. The Dudley Electric Motor Street Car company were granted a charter by the council some weeks ago, the two streets named being included as part of their route. The Citizens' company immediately began laying track in several places on these streets but were stopped by a temporary injunction. The suit just decided was for a permanent injunction. It was shown that the Citizens' Street Railway company's right to incorporate and to own and operate a street railway line had been granted by the state. It was under this State law that the company accepted its franchise. On January 18, 1864, the city, by ordinance gave its "consent, permission and authority to said company and its successors to lay tracks" upon certain streets among which were those named above. A representative of the Dudley company says: "I have telegraphed our folks about the decision and I do not expect to know before to-morrow what they will do. However, we have the same rights that the other company has been given, the ordinance being almost an exact copy of their franchise. My belief is that it is the beginning of a fight between two corporations, and I do

not believe that our people will yield their rights to the street."

Indianapolis is still using gas for street lighting and from present indications is likely to continue for some time to come. The committee on public lights made its report to the city council at its meeting Monday night, but after a lengthy discussion, a motion was carried to refer the whole matter of light back to the committee for further report to be ready for a called meeting of council Monday night next. It is evident from what can be learned if the contract is given to one of the electric companies they will have calls for any amount of private lights if they make reasonable rates. M.

From Louisville, Ky.

LOUISVILLE, Ky., July 20.—This city at last has an inspector of electric lights, although it took considerable work on the part of those interested in these matters to secure such an office. The electrical interests in this city have been growing so extensively for several years that the need of an officer of the kind has been felt. All the large buildings are webbed with wires. Careless employes sometimes do not attend to these properly, and accidents sometimes result. The electric light men themselves were anxious to have an inspector. Finally the matter was proposed to the common council of the city, and the mayor, who is an enterprising man, favoring all useful inventions, pushed it forward. Some of the old fossils in the board fought the measure bitterly, but it finally went through. The mayor was given the appointment of the inspector, and he selected a most capable person, W. H. Johnson, who has been interested in electrical matters for many years. Mr. Johnson has the power to enter any building in the city where electric lights are used, and if the wires are not in proper condition his order to have them attended to at once must be obeyed.

The chief of the fire department has been raising a great cry against placing electric light wires overhead. He insists that they are a nuisance as they are exceedingly dangerous to firemen and also render good work at fires in large buildings impossible, not only on account of the danger caused by contact with them, but because their great number renders approach with ladders a matter of much difficulty. This complaint has raised much talk of a law requiring all electric light wires to be placed underground. The fact remains, however, that in spite of all the complaint there has not in the history of the city been a single case of death or serious accident resulting from contact with the electric light wires, and in no case has the work of firemen at a burning building been impeded by them. Hence it is safe to say that all the talk will amount to nothing, and the wires will remain for some time as they are—overhead.

Louisville is to have an electric street railway soon. B. du Part the owner of the wealthiest street car corporation here has secured the right of way on Green street, and will have a line of cars upon it run by electricity. Work has already been begun. Some of the rails have been laid and the road is to be running in a few months. This will be quite a curiosity in Louisville which has never yet had anything of that kind.

The electrical business is rather lively here considering the summer season. Several of the smaller Kentucky cities are introducing electric lights and come to Louisville for their supplies. More of the stores here are also putting them in. They are also used more at night as street lights. On three of the principal business streets—Market, Jefferson and Fourth, the merchants have clubbed together, and have placed electric lights over the streets, at close intervals and for a long distance. These lights remain until midnight, and the streets are bright as broad daylight.

Louisville is to have a grand fall celebration. One of the features upon which its managers are relying most is a brilliant illumination of the business part of the city with electric lights in globes of all colors. They will be kept up all night and the illumination will last a week. A.

General Newton of the New York Board of Electrical Control is quoted as saying that he did not propose to be a shuttlecock flying between the battledores of the board of electrical control and the electric light people. "Here is the situation," he continued. "The board of electrical control reports that certain poles are 'dead' or unused. If that is so, they ought to be removed; and the bureau of incumbrances has power to do it. But the president of the light company, on the other hand, asserts that these poles are in actual use and were lawfully erected. If this is true, I have no authority to order their removal except when so directed in writing by the mayor. Now which am I to believe, the United States Illuminating company or the inspectors of the subway board? I have asked Corporation counsel Beekman to tell me, and am awaiting his reply. If I should order the removal of some poles and wires alleged to be out of use, and they should prove to be live and carrying a powerful current, some one would be killed. I have no wish to be defendant in a trial for manslaughter, as would be likely to follow."

THE ELECTRIC LIGHT.

Electric lights in cakes of ice is a novelty for the illumination of ballrooms abroad.

The Waterhouse Electric Light company will install a plant of 200 incandescent lights at Ensenada, Cal.

The Western Electric company is in receipt of an order by cable for an electric light plant for Sydney, Australia.

The Monroe Electric Light & Power company of Monroe, Mich., has been incorporated. The capital stock is $12,000.

George Tilles, lessee and manager of the Grand Opera house, at Fort Smith, Ark., has contracted for an Edison electric light plant for his place of amusement.

July 11th, San Francisco Association No. I, N. A. S. E., inspected the plant of the Oakland Electric Light and Power Company, and were well pleased with the visit.

Whitelaw Reid's mansion at Ophir farm, near White Plains, was destroyed by fire last Saturday. The loss is $250,000. The house had recently been supplied with an electric light plant and several motors.

It is thought in Chattanooga, Tenn., that the Brush company and the Hauss Electric Light company will combine for lighting the town, the Brush company taking the arc lighting and the Hauss company the incandescent.

The Oregon Improvement company has purchased of the Waterhouse Electric Manufacturing company of Hartford, Conn., an arc and incandescent plant for its machine shops, wharves and railroad station at Seattle, Washington territory.

The Virginia & Gold Hill Electric Light company of San Francisco, has been incorporated with capital stock of $250,000. The incorporators are W. E. Sell of Berkeley; A. W. Rose, Jr., of San Mateo; C. T. Bridge, N. D. Anderson, Chas. S. Wheeler, San Francisco.

The Waterhouse system of arc lighting was installed at the Whitin Machine Company, Whitinville, Mass., last year, and was so satisfactory that they have ordered of the Waterhouse Electric & Manufacturing Company, of Hartford, Conn., 135 arcs additional, making a 170 arc light plant.

Two delegates have been sent from Spain to France and England for the purpose of investigating and reporting upon the different systems of lighting. They ought to come to America for such a purpose. Even English electricians admit that in point of practice their American cousins are far ahead.

The Western Electric company has secured the contract for lighting the exposition at Chicago this fall with 200 arc lights and a considerable number of incandescents. A feature of the electrical installment will be the furnishing of current to a considerable number of Baxter motors for furnishing power to exhibitors.

A gas stock broker when asked what effect electric lighting was having on the gas companies, replied: "The effect has been to icrease the use of gas. This is remarkable but nevertheless, the facts prove it to be the case. This and natural growth of the population has required nearly all the gas companies to increase their plants."

Telephone operators do not always feel kindly disposed to electric light companies. Here is a case in point: A total extinction of all the lights fed from the central station in the Friedrichstrass, Berlin, occurred lately, owing to the breaking of one of the cables. The lights had not been extinguished for more than a few seconds when the central telephone station received 300 simultaneous calls for communication with the electric lighting company.

Joseph Reinstein, who was injured in the explosion at the Bell clothing company's store, in Chicago, has brought suit against the Chicago Arc Light Power company to obtain $5,000 damages. He was in the basement at the time of the explosion, and he alleges his injuries will result in permanent disfigurement. The explosion, it will be remembered, was caused by the leaking of gas from a main which was broken by the electric light company's employes in forcing a tube under the sidewalk.

The brief dispatch in last week's issue concerning the destruction of the Westinghouse plant at New Orleans, La., has been confirmed by later dispatches. The station was totally destroyed, and the loss is placed at $100,000; insurance about $50,000. The cause of the fire was a lighted lamp which fell on a bucket of oil. The agent of the Westinghouse Company in a published communication states that arrangements are being perfected for the operation of a new plant in a short time, and asks that patrons burn gas economically, offering to defray whatever additional expense they are subjected to through the loss of the plant.

The following dispatch, dated July 20th, was sent from Ottawa, Can.: Proceedings will be taken in the Patent office next September to annul the patents for Edison's system of electric lighting in Canada for non-compliance with the requirements of the patent act. The petitioners are the Thomson-Houston Electric Light company, of Boston, with agencies in the Dominion, and the Royal Electro company, of Canada. R. D. McGibbon, counsel for the petitioners, thinks it is likely that the necessity for entering into the merits of the case will be obviated owing to the recent decision of the English courts canceling the Edison patents in Great Britain, which will have great weight in Canada.

At the meeting of the San Francisco city council street light committee, July 9, it was decided to advertise for proposals to furnish twenty-one electric masts, 150 feet high, and of 16,000 candle power, and 102 masts, forty feet high, of 2,000 candle power; also, seventy-seven other lights, the elevation of which will be determined hereafter. The board is to reserve the right to change the height or location of the masts at any time they think it necessary. The twenty-one masts of 16,000 candle power lights will remain in the same locality as at present, except the two formerly situated on the corner of Point Lobos avenue and Cook street, and on Point Lobos and First avenues. They have been removed, one to Mission road and Silver avenue, and the other to Ocean View. To replace the lamps taken from Point Lobos avenue, eight masts, forty feet high, and of 2,000 candle power each, will be erected between Fifth and Central avenues. The committee adopted the same report for supplying gas for city purposes as that of last year, except that 5,400 lamps will be used instead of 5,100,

St. Catherine's lighthouse, on the southern extremity of the Isle of Wight, now possesses the most powerful electric arc light in the world. The carbon pencils are two-and-a-half inches in diameter, the interval between them half an inch, and the light developed equal to 60,000 candles. The lamp is a modification of the Serrin-Berjot type, and the carbons are fluted to promote centrality of the arc. The current is generated by two dynamos constructed by De Meritens of Paris, the induction arrangement consisting of sixty permanent magnets, each magnet being made up of eight steel plates. The armature, two feet six inches in diameter, is composed of five rings, with twenty-four bobbins in each, arranged in groups of four in tension and six in quantity. The revolving lens is constructed so as to refract the light in sixteen radial beams, and this is actuated by a small vertical engine at such a speed that flashes of five seconds duration are given every half minute.

J. W. Swan, whose interesting article on artistic use of incandescent lamps was recently printed in the WESTERN ELECTRICIAN, practices what he preaches. The London *Electrical Engineer* says: Mr. Swan's house is very beautifully fitted throughout with the incandescent electric light, and constitutes a sight of very considerable interest and beauty. The living rooms are fitted with daintily tinted electroliers, supplied by a dynamo, gas-engine, and accumulators in an outhouse near. The grounds are lighted with large incandescent lamps of 500 candle power making the whole garden at night clearer than moonlight. The dynamo is a unique type, of Mr. Swan's own design probably as perfect a machine as is possible to make. Its field magnet is one huge ring of soft iron, on which flattened rings of insulated copper tape are separately slipped, soldered together on connection at the top. This arrangement allows radial spaces round the outside of the field magnet, which by this means remains probably cooler than any other type of machine. In the engineroom a small motor was arranged, lent for the occasion by Messrs. Immisch & Co., which, mounted on a pedestal, was made to drive the lathe in the laboratory adjoining, the current being obtained from the battery of accumulator cells. The running of this powerful, but diminutive, motor excited a good deal of interest; an explanation was appended, indicating how mechanical motion was obtained by the continual chasing round and round by the poles after magnets which they could never catch.

THE ELECTRIC MOTOR.

An electric street railroad on the Highlands would not only prove a great benefit to the people in that section of the city, but to the city at large, says the Lynn, Mass., *Bee*. It would increase the value of property on the Highlands.

So many strange craft are, from time to time, seen at Henley, says the London *Standard*, that it is difficult to imagine anything fresh; but in addition to canoes of every known type, to row boats of every size and build, there is this year a novelty in the shape of the electric launch of Immisch & Co. At present the only specimen afloat at Henley is the Malden, but another one, capable of carrying seventy persons is in course of construction. How far the difficulties incidental to charging the accumulators just when wanted will be got over remains to be seen; but the convenience of a fast traveling boat with no smell of oil and no blacks from the funnel to soil the fairest of frocks is obvious.

In a great many cases electricity is forced to do work which steam should have done before being turned into electricity, says the *Manufacturers' Gazette*. It is too much like a correspondent who wishes to drive an electric motor by a primary battery, and get electric light from a dynamo driven by his motor. Such round-about methods are constantly being proposed for the application of electricity, because some persons never stop to think that the electric light could be derived direct from the primary battery, without interposing either motor or dynamo. No man would think of running a steam engine to pump water into a waterwheel for the sake of saying "run by water," but many people do persist and insist upon using electricity in just such a foolish manner. Let electricity do the work fitted to it, but do not carry its application to an extreme.

The question of the water supply has for some time been exercising the minds of all classes in Poynton, a Cheshire village, and especially so during the recent dry weather, says the London *Electrical Review*. The attention of Lord Vernon has been called to the scarcity of water, and he is just adding a new supply, which will place the village in a much better position than it has ever before enjoyed. His lordship has sunk a well eighty-four feet in depth to the new red sandstone, about half a mile from the reservoir, and is arranging to pump the water and carry it by means of pipes to the reservoir. The arrangements for pumping are as follows: A small engine has been placed at the Lady Pit, where the pumping operations of the collieries are carried on. This engine, worked by the boilers at the pit, drives a Gramme dynamo, which acts as a generator. An electric motor is fixed at the top of the well, and this motor drives, by means of belt gearing and cranks, two ordinary ram pumps having 3½ inch rams and 9 inch stroke fixed in the well. When ordinarily working, the speed of the dynamo and motor will be about 800 revolutions per minute, and the speed of the pumps about 40 strokes per minute. At this speed the quantity of water pumped into the reservoir will be at the rate of about 1,200 gallons per hour.

THE TELEPHONE.

The Hopkins & Norman Big Bend Telephone system has been extended to Medical Lake, W. T.

The Bellingham Bay Telephone company of Whatcom, W. T., will erect and operate telephone lines throughout Whatcom, Skagit, Snohomish, King and Pierce counties.

The long-standing grievance of the vesselmen of Chicago, against the Northwestern Railroad bridge near Kinzie street, is at last in a fair way to be adjusted. The bridge was placed in the telephone system last week, and will be operated by the vessel dspatcher. This will enable him to work the railroad and the Kinzie street bridge together hereafter, and both will open and close at the same time for the passage of vessels.

A dispatch from Parkersburg, W. Va., dated July 13th, says: While Manager J. E. Mayhew of the telephone lines here was repairing a wire this evening an electric wire entangled with the telephone wires gave him a shock, burning his arms and body. Had not his assistant, Tappin, rushed up the pole and with great danger to himself cut the electric light wire, Mayhew would have been killed. He was hanging to the cross-bar limp as a rag and his head bobbing about when Tappin picked him up in his arms and carried him to the ground below. Mayhew is terribly hurt, and may not recover.

When the day express from the east pulled into the Central station yesterday afternoon a party of fifty men alighted from the train, says the Rochester *Herald*. Each one carried a gripsack and it was evident that they were workmen of some sort. A reporter ascertained that the men were employes of the American Telephone Telegraph company of New York city, one of the incorporated bodies under the general control of the directors of the Bell Telephone company. This company is now building a long distance line from New York to Chicago. It is already built from New York to Syracuse. The company of men already referred to was in charge of a foreman and left for Avon on the 5:10 P. M. train on the Western New York and Pennsylvania road. Work will be immediately begun in that vicinity on the section between Syracuse and Buffalo, and will be pushed in both directions. It is believed that a loop line will be constructed from Avon into this city if any desire for such a connection is manifested here. It would certainly be a benefit to Rochester's citizens to be able to "call up" the metropolis or to have a brief talk with some Chicago friend. All those who are familiar with long distance telephoning believe that it has passed beyond the experimental stage and become an assured success. Among other proofs of the value of the system it is stated that the only communication between New York and Boston during last winter's blockade was over a long distance telephone.

THE TELEGRAPH.

The telegraphers of New York will hold their fifth annual summer-night festival at the Empire City Coliseum, 68th street and East river, Friday, August 3d. The affair is in charge of the following well-known telegraphers: Messrs. English, Hart, Hernon, Foster, Newton, Morrison, Smollin, Felleman, McSwyny, Quick & Walsh.

An injunction was granted restraining Lewis Van Amberg, a Cascade township farmer, from cutting down the telegraph poles of the Grand Rapids, Lansing Detroit road, says a Grand Rapids, Mich., dispatch. He claims that the right of way does not embrace the land where the poles are set, and has so far succeeded in keeping the company without direct telegraph facilities.

Recently lightning took to the telegraph wires along the B. & P. road, in the town of Lagrange, Me., running for over a mile. About twenty poles were split from the top to the ground as though cleft with powder. The electric wave played zigzag in the sky, thoroughly frightening the people round about. The station agent at Lagrange says it cracked them up in good shape, and that the report was like the bursting of a bladder in his ears.

Suits for sums aggregating about $40,000 have been instituted by City Solicitor Warwick, Philadelphia, on behalf of the city against the Western Union Telegraph company in the Court of Common Pleas. This is the beginning of a litigation which the telegraph company proposes to fight through all the courts from the Common Pleas to the United States Supreme court. The claim of the city is for the license fees for telegraph poles in the city of Philadelphia.

The following dispatch, dated July 18th, comes from Ottawa, Ont: Owen Jones, one of the directors of the Pacific Cable company, has returned from the Australian colonies en route for London, having successfully negotiated with the colonies and the Hawaiian Government for a subsidy for laying the cable from Vancouver to the Hawaiian, the recently annexed Fanning and Fiji Islands, New Zealand and Australia. It is understood that her majesty's ship Egeria began soundings seven weeks ago from New Zealand to Fanning. The cable will be 6,800 miles long, but the longest stretch will not be over 2,000 miles. Mr. Jones, who will confer with the Canadian Pacific directors in Montreal, says the project meets the heartiest approval of all the colonies.

A dispatch which contains a denial of the story which it purports to give comes from New York, as follows: It was rumored in Wall street to-day that negotiations were in progress for the sale of a controlling interest in the Western Union Telegraph company to the Vanderbilts. The report was started undoubtedly for effect on the stock market and it could not be learned that it had other than a speculative basis. It might not have attracted any attention if Mr. Gould had not gained the control from William H. Vanderbilt. The possibility that the property might return to his sons was sufficient to excite a languid curiosity. John T. Terry, a member of the executive committee, said that there was not the slightest foundation for the rumor so far as he knew, and another member of the board declared that it was absurd. An intimate friend of Mr. Gould's said it was impossible that a transaction of such magnitude could be made at present, for, while Mr. Gould was constantly improving in health, he was not giving any attention to business matters, and a sale of the Western Union would not be made without his careful consideration of all the details.

The cable seems to be receiving great attention from gossipers and those who delight to form conjectures. Here is the last story: A dispatch from Carson, Nev., says: The *Appeal* says: "The *Appeal* has it from reliable authority that John Mackay has disposed of his cable to Jay Gould for $11,000,000. The negotiations had been pending for some time. Mackay originally asked $13,000,000, but Gould refused the cable at these figures, and finally offered $11,000,000, which was accepted." It is almost unnecessary to add that Mr. Mackay promptly denied the rumor. Dr. Norvin Green, president of the Western Union Telegraph company, said: "The report is not true. It probably originated through some garbling of a statement that an arrangement has been arrived at to raise the cable rates. This is a fact. Negotiations with that end in view have been pending for some time. Mr. Mackay has been for a considerable time in Virginia City. Mr. Gould has not seen him. He did not go as far as that on his western trip. Nobody else on our side has had any direct communication with Mr. Mackay. We have had no communication with his lieutenants here, Mr. Chandler and Mr. De Castro. Mr. Mackay's secretary, through whom cipher messages had to be sent, has been in San Francisco, so that the negotiations I referred to have been slow."

A petition in chancery was filed last week in the Circuit court, Chicago, to set aside an order and decree of the same court in the famous case of Jeremiah Terwilliger et al. vs. the Great Western Telegraph company et al. The petitioner is Selah Reeve, who says that the suit has been pending since 1874, and he is a party defendant. He says that he furnished electric lines and appliances for the construction of several hundred miles of line for the telegraph company, his bill amounting to $239,366.24. He retained attorney Thomas J. Sutherland to collect the moneys due him. The company had outstanding unpaid stocks and subscriptions which were liable for the payment of his claims, but Sutherland told him nothing about this. On this account Reeve assigned his claim to David A. Gage, with the understanding that the property of the Great Western Telegraph company was to be assigned to the Western Union Telegraph company. He claims that these conditions were never fulfilled. Sutherland then went to Denver, Col., so the petitioner says, and by false representations obtained the papers from him. Then Sutherland moved that the suit to be carried on for his own benefit, which was agreed to, and by false representations had the property and interest transferred to himself. The case was called before Judge Barnum, who decided that Sutherland was the sole owner of the property in dispute, and referred the matter to Master in Chancery Horatio L. Wait, who decreed that the telegraph company was indebted to Reeve in the sum of $154,861.25 The Circuit court ordered that Reeve recover that amount for the use and benefit of Sutherland, and that it be paid to him as the receiver of the company. Mr. Reeve now desires that this decree be set aside, as he claims that he is the sole owner of the property.

Miscellaneous Notes.

The Electric Appliance company has been incorporated at Phillipsburg, Pa., with $30,000 capital stock. The company will manufacture electric light globes,

The Elmer A. Sperry Company, of Chicago, Ill., has been incorporated, with Elmer A. Sperry, George Lawrence, Jr., and J. F. Marsh incorporators. The company will engage in general electrical manufacturing.

The Universtty of Wisconsin, at Madison, will have a similar electrical equipment to that of the Rose Polytechnic Institute at Terre Haute, Ind., referred to last week. Prof. John E. Davis, while in Glasgow saw the new instrument in course of construction and ordered a duplicate set for the University of Wisconsin.

Mail phonograms will differ somewhat from those ordinarily used, says an exchange. The latter are made of a wax composition whose process of manufacture is a secret. Mail phonograms are made of paper coated with wax. With the improved phonograph it is not necessary to place tubes to the ears of the receiver. Mr. Edison's baby daughter is about three months old. She is no exception to the general run of babies, and when she doesn't like a thing it is not necessary for her illustrious father to go to the phonograph for enlightenment on the subject. Mr. Edison has let her cry and lisp "Da-da" into the improved phonograph which he has in his house, and when the young lady grows up, she will have an opportunity to hear the exclamations of her interesting infancy.

Business Mention.

The Sprague Electric Railway & Motor company has just sold a five horse-power standard motor to be used in the mammoth dry goods establishment of Barnes, Hengerer & Co., of Buffalo, for running a large number of sewing machines. Current will be supplied by an Edison dynamo used in lighting the building.

The Postal Telegraph company has just placed an order with the Western Electric company for underground cable. One of the first pieces of Patterson cable laid underground was put down for the Postal Telegraph company six years ago, and is working perfectly to-day. The new cable just ordered by the Postal Telegraph company is an extension of this original cable.

Electrical Patents.

Issued July 17, 1888.

386,103. Secondary Electric Clock Movement. Carl Bohmeyer, Halle-on-the-Saale, Prussia, Germany.

386,111. Electric Wire Insulator. Henry H. Cutler, Newton, Mass.

386,129. Automatic Telegraph Transmitter. Zeroy P. Hotchkiss, Oak Park, Ill.

The first and last claims follow: "1. In a telegraphic transmitter, in combination with the series of movable strips, the series of key levers below the same, each provided with one or more lugs adapted to engage and lift one or more of the strips as the lever is operated.

"28. In a telegraphic transmitter, in combination with the mechanism for driving the transmitting devices, the fan shaft and the fixed fan thereon, the sliding sleeve on the shaft, the rod connected with the sleeve, whereby said sleeve can be slid on the shaft toward or from the fan, and the plate connected with the sleeve so that it can rotate but must move with it along the shaft, all substantially as shown and described, so that the speed of the transmitting devices can be regulated at will by moving the rod connected with the sleeve."

386,149. Galvanic Battery. Abraham V. Meserole, New York, N. Y.

Claims: "1. A depolarizing agent or material for galvanic batteries, containing hydrate and oxide of copper.

"8. In a galvanic battery, the combination, with the positive electrode, of the trough suspended beneath said electrode to receive the matter falling therefrom."

386,150. Galvanic Battery. Abraham V. Meserole, New York, N. Y.

The last claim follows: "5. The combination, with a carbon electrode and an alkaline chloride exciting fluid, of a depolarizing agent or material containing hydrate of copper."

386,175. Police Signal Apparatus. John C. Wilson, Boston, Mass.

The invention is embodied in an apparatus having appliances by which citizens may transmit signals from numerous sub-stations to a station house or other main or central office to summon police aid, and by which policemen or other authorized persons may transmit any one of a series of predetermined or special signals to a station or main office to make known the various wants that are likely to occur in connection with the police service, and by which signals may be transmitted from the main office to any desired one of the signal boxes or sub-stations, the transmission of said signal being controlled from the sub-station, while its character is determined at the main station, and whereby the same circuit that is employed for signaling may also be used for telephonic connection, the telephone not being subjected to the action of a strong battery current.

386,184. Electric Railway. Robert A. Chesebrough, New York, N. Y.

386,189. Electric Bulletin. Patrick B. Delany, New York, N. Y.

The object of the invention is to provide a system for the dissemination of news, having a central office at which all current matters of interest are reported, and bulletins located at subscribers' stations and capable of being operated from the central office to indicate or display to the observer the transmitted information.

386,225. Electrical Distribution by Storage Batteries. George W. Walker, Bethlehem, Pa

386,281. Method of Blasting. Montgomery Waddell, New York, N. Y.

386,282. Tunnel Construction for Electric Railways. Granville T. Woods, Cincinnati, Ohio.

386,340. Dynamo Electric Machinery. Georges Miot, Paris, France.

Claim: "1. In a multipolar dynamo and in combination with the armature thereof, a series of field magnets with simple magnetic poles arranged about the said armature with the several poles or enlarged polar extremities nearer to a pole or enlarged polar extremity of unlike sign of a neighboring magnet than to the other pole or enlarged polar extremity of its own magnet."

386,380. Telephone Transmitter. Charles W. Brown, Montreal, Quebec, Canada.

386,403. Apparatus for Preventing Collisions of Railway Trains. Jack W. James, Cuba, Tenn.

386,441. Apparatus for Electric Welding. Elihu Thomson, Lynn, Mass.

The invention relates to an improvement in electric welding apparatus whereby a number of pieces may be simultaneously subjected to the action of the welding currents.

Claim: "1. In an electric welding apparatus, a plurality of pairs of clamps arranged for holding a number of pieces to be welded in juxtaposition."

REISSUED.

10,944. Electrical Conductor. Edward Weston, Newark, N. J.

The last claim: "7. A rheostat, resistance, or other electrical instrument of the kind described, the conductors of which consist of two portions, one composed of a metal or an alloy the electrical resistance of which increases with an increase in its temperature, the other of an alloy the resistance of which decreases under similar conditions."

10,945. Electrical Conductor. Edward Weston, Newark, N. J.

Claims: "1. An electrical conductor consisting of a material the electrical resistance of which is substantially constant under varying temperatures.

"5. A coil or conductor wound in convolutions composed of copper and ferro-manganese, in the proportions of seventy parts of copper and thirty parts of ferro-manganese.

"6. A rheostat, resistance, or other electrical instrument of the kind herein described, the coils or conductors of which are composed of an alloy of manganese and copper or its equivalent."

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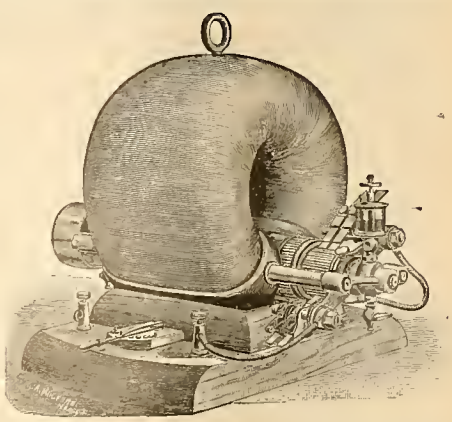

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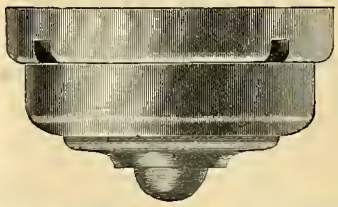
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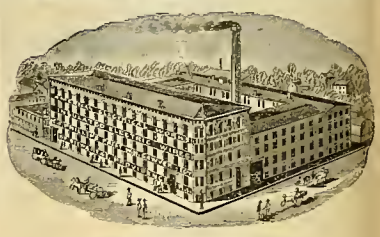
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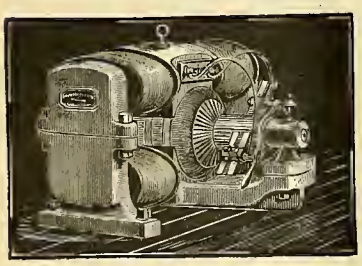
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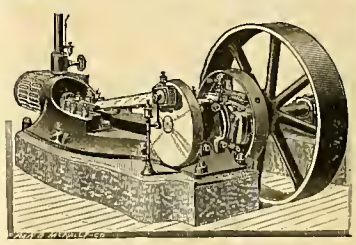

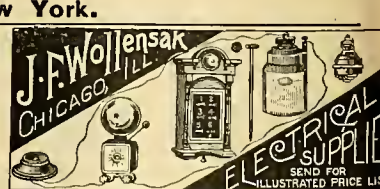

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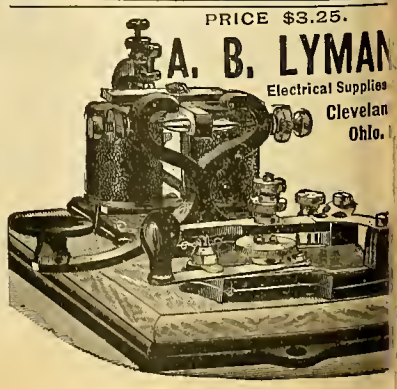

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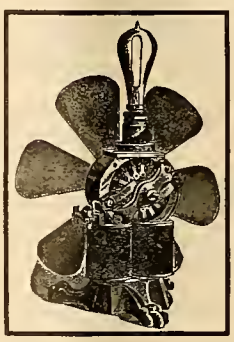

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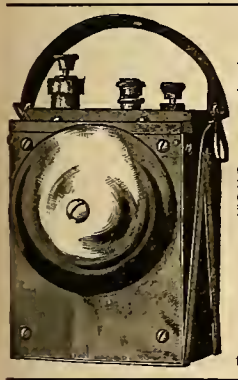

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Electrician, V. D. P. E. M. Co.

Sure protection from all Electrical and Magnetic disturbances.
Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

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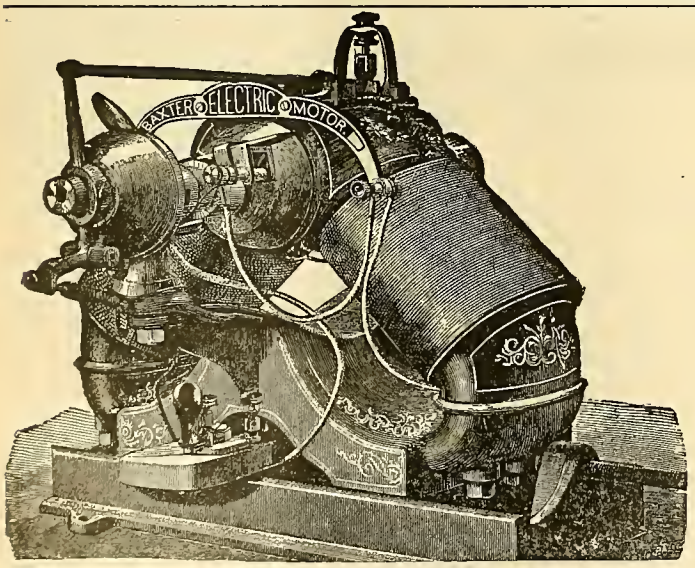

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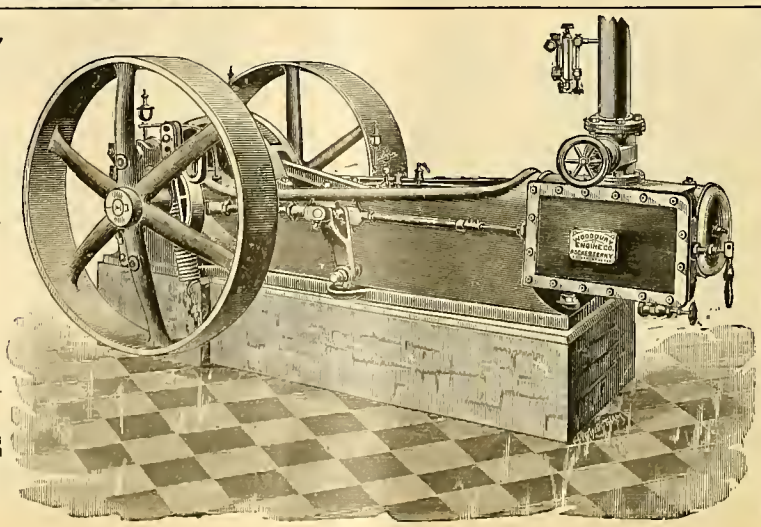

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J. A. DYBLIE, Engineer.
G. E. FISH, Electrician.

CHICAGO, July 19, 1888.

C. D. WRIGHT, ESQ., Petersburg, Ill.:

DEAR SIR:—Some three weeks ago you left with me one of **Wright's Armature Protectors.** When you left this instrument with me you made the statement that by its use in connection with dynamo machines, all danger of injury to the machines from short-circuiting would be obviated, and that no machines can burn out if protected by this instrument. You also requested that I take the instrument, put it into our station, and thoroughly test it, and after making such tests as I thought necessary in order to enable me to arrive at a conclusion regarding its usefulness, to write you stating what I thought of the Protector.

I have had a good deal of experience in connection with the practical operation of Electric Light Stations, and consequently know the liability of even the best and most thoroughly insulated machines to occasionally burn out their armatures. I have therefore taken a good deal of interest in the Protector, and in giving it a protracted and thorough test.

I have now had the instrument you left with me up and in position three weeks, and have watched it closely during that time. I have frequently short-circuited the entire number of lights on the machine, thus putting the Protector to its fullest test. As everybody at all familiar with the operation of electric light machinery knows, the short-circuiting of a machine in this manner would mean sure destruction of the armature without the Protector. With the test I made, however, using the Protector, the short-circuiting had no effect whatever on the running of the machine. The machine ran right straight along without the slightest disturbance, thus proving conclusively that the Protector does just what you claim for it, namely, absolutely protects the armature from injury when the machine from any cause becomes short-circuited.

I cannot too highly indorse your Armature Protector, and I certainly think and would recommend that every Dynamo in use should be protected by it.

Yours truly,

G. E. FISH, Electrician.

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TABLE OF CONTENTS.

	PAGE.
ELEMENTARY DATA—	
The Electric Current, Chapter I	1, 2
Ohm's Law, Chapter II	2
Work, Chapter III	2
Conductors and Insulators, Chapter IV	2
Direction of the Current, Chapter V	3, 4
Detector Galvanometer and Magneto Bell, Chapter VI	5, 6, 7
ARRANGEMENT OF POWER—	
The Dynamo Room, Chapter VII	8
Motive Power, Chapter VIII	8
Shafting and Pulleys, Chapter IX	9
Foundations for Dynamos, Chapter X	9, 10
Belts, Chapter XI	10
DYNAMO ELECTRIC MACHINES—	
Description of the Dynamo, Chapter XII	11
The Continuous Current Dynamo, Chapter XIII	11, 12, 13, 14
The Series Dynamo	11, 12
The Shunt or Derived Circuit Dynamo	12, 13
The Compound Dynamo	13, 14
The Alternating Current Dynamo, Chapter XIV	14, 15
Preparation of a New Dynamo for Operation, Chapter XV	15, 16
Starting a New Dynamo, Chapter XVI	16
Keeping a Dynamo in Good Order, Chapter XVII	12
Brushes, Chapter XVIII	17, 18, 90
The Commutator, Chapter XIX	19, 17
Repairs, Chapter XX	20, 21
To the Armature	20, 21
To the Field Magnets	21
Testing the Wire Coils of a Dynamo for Contact Against Iron, Chapter XXI	21, 22, 23, 24
DISEASES OF DYNAMOS—	
Non-generation of Current by the Dynamo, Chapter XXII	25, 26
Excessive Sparking of Commutator and Brushes, Chapter XXIII	26, 27
LAMPS—	
Arc Lamps, Chapter XXIV	28, 29, 30, 31
Suspension of Arc Lamps, Chapter XXV	31
Trimming and Cleaning Arc Lamps, Chapter XXVI	32
Incandescent or Glow Lamps, Chapter XXVII	32, 33
Multiple Arc System, Chapter XXVIII	33
Multiple Series System, Chapter XXIX	33, 34, 35
Series Multiple System, Chapter XXX	36
Arc and Incandescent Lamps on the Same Circuit, Chapter XXXI	36, 37 38
The Alternating System, Chapter XXXII	38
INSTRUMENTS—	
Current Indicator or Ampere Meter, Chapter XXXIII	39
Pressure or Potential Indicator, or Voltmeter, Chapter XXXIV	39 40
Current Regulator, Chapter XXXV	40, 41
Switches, Chapter XXXVI	41, 42
Safety Devices, Chapter XXXVII	42, 43
Lightning Arresters, Chapter XXXVIII	43, 44
Ground Detector, Chapter XXXIX	45, 46
Switch-Board, Chapter XL	46, 47
CIRCUITS OR LEADS—	
Outdoor Leads for Arc Lighting, Chapter XLI	48, 49, 50, 51, 52, 53
Outdoor Leads for Incandescent Lighting, Chapter XLII	53, 54
Arc Circuits Inside of Houses, Chapter XLIII	54
Incandescent Circuits Inside of Houses, Chapter XLIV	55, 56, 57
Size of Wires for Incandescent Lamp Installations, Chapter XLV	57, 58, 70
Testing, Chapter XLVI	58
ACCUMULATORS—	
Accumulators, Chapter XLVII	59
SAFETY REGULATIONS—	
Rules of the Boston Underwriters' Union	60, 61, 62, 63, 64, 65, 66
English Regulations	66, 67, 68
Abstract of the Chicago Electric Light Laws	68, 69
Table of Electric Light Conductors	70
Lamp Lighting Schedule—Moonlight System	71–82
Construction Tools	83-89

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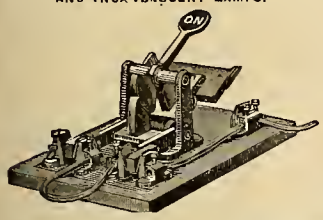

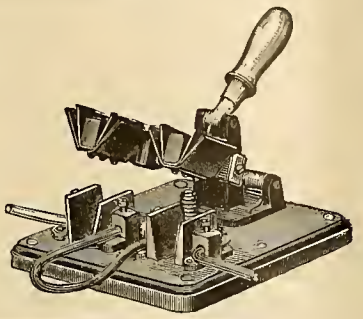

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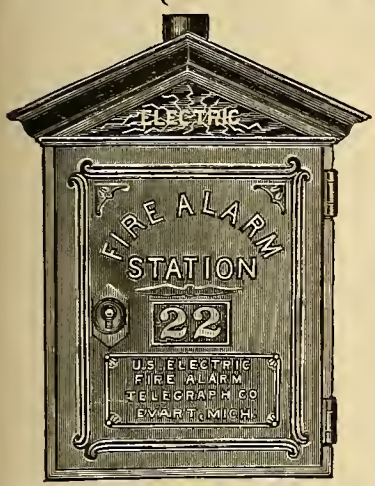

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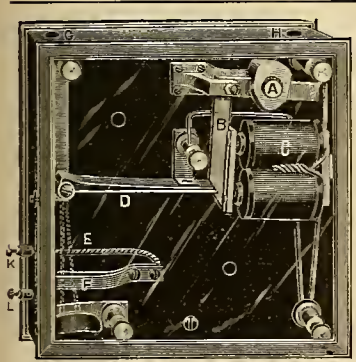

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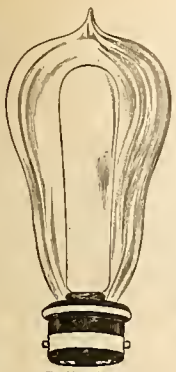

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The burglar of the present day is no novice. He has not turned burglar because he could not obtain honest employment. He is a burglar from choice. He is a burglar by profession. The "profession of burglary" has, among its followers, men of quick, active brains, who are far more than a match for the watchfulness of the majority of our citizens —men who do not consider the ordinary policeman an enemy or the detective force a necessary impediment to their sound slumber—men whom watchmen, big dogs or little dogs, would bother no more than an ordinary, everyday mosquito would bother the hide of a rhinoceros.

There is, however, something that does bother them, and that "something" is Electrical Alarms. In this knowledge there is

MONEY FOR "ELECTRICAL" MEN.

If a man has enough in his home to steal, he has enough in his pocket to pay for protection—he has also sense enough to decide that modern electrical appliances are worth all the special watchmen, dogs, bolts, bars, etc., combined. What better protection can be secured for private house or public office or store than the Applegate Electric Burglar Alarm Matting. It is concealed beneath the carpet—there is no manner in which it can be located—one step on it and the robber s presence is revealed—his plans are foiled—it may land him in the penitentiary. Is it any wonder that the robber considers the electric matting as an unseen foe and shuns any possibility of coming into contact with it ?

All engaged in electrical work are advised to look around them in their own town or city and see if there is not a good demand for Electric protection.

The following are a few of the very many indorsements this matting has received:

CITY OF CHICAGO, DEPARTMENT OF POLICE,
City Hall, Feb. 25, 1888.

GENTLEMEN:—I have had the pleasure of observing the working of the Applegate Electric Burglar Alarm Floor Matting and connections, and am frank to say that IT IS THE BEST I EVER SAW. Respectfully,

GEO. W. HUBBARD,
Gen'l Sup't of Police.

CHIEF HENSHAW SPEAKS.

POLICE HEADQUARTERS,
CHICAGO, Feb 27, 1888.

GENTLEMEN:—I am satisfied that the Applegate Electric Burglar Alarm Matting is the correct principle for the DETECTION OF BURGLARS; and as a burglar alarm, I think it CANNOT BE EXCELLED Very truly,

HENRY D. HENSHAW,
Chief of Detectives.

PROTECTION IN TIME PREVENTS BURGLARY.

G. W. FAIRCHILD, Watches and Diamonds.
357 Main and 8 John Sts,
BRIDGEPORT, CONN., Aug 4, 1887.

MY DEAR SIRS:—After the experience of having my my store burglarized on the morning of July 17 last, and having the larger part of my stock of diamonds, watches and all other valuable jewelry to a very large amount stolen, I negotiated with you to put in your patent system of perfect Burglar Alarms, which is now in active operation in my en tire store and to MY ENTIRE SATISFACTION, and I WOULD ONLY ADD THAT I WOULD NOT BE WITHOUT your Burglar System FOR ANY PRICE, as I consider it PERFECT IN EVERY RESPECT.

Very truly yours, G. W. FAIRCHILD.

AN ELECTRIC LIGHT MAN TO THE FRONT.

PRESIDENT OF THE BRUSH ELECTRIC CO. writes:

I think this a valuable invention, and one that will afford protection where others fail.

M. D. LEGGETT,
President Brush Electric Light Co.

IT STANDS THE TEST OF TIME.

FROM PRES. OF PHILADELPHIA LOCAL TEL. CO :

PHILADELPHIA, 4th Mo., 10, 1887.

I am pleased to say that Applegate's Electric Floor Mat Alarm, put in my office nearly eight years ago, gives us great satisfaction, and is worthy of all that can be said in its favor. Very truly,

HENRY BENTLEY, President.

POINTS TO BE REMEMBERED.

1. Electrical men make money by putting in burglar alarm matting, and business and professional men save money by having its protection.
2. Do not use poor material in connection with the matting —the Diamond Carbon Battery and P. & B. House-wire should always be used.
3. The Electrical Supply Co., 171 Randolph St., Chicago, sells this matting. Write for further information.

IS KERITE INSULATION THE BEST?

We once read about a frog that grew jealous of the size of a bull, and wished to become as large. The frog blew some and became somewhat inflated—perhaps his friends called out "keep on froggy, you'll get there"—anyway he kept on blowing and getting inflated. One day this frog had puffed himself out to twice his usual size—his friends applauded, and in an endeavor to attain still nearer the size of the bull, he b-u-s-t

In kindness to some of our friends, who are jealous of Kerite, and are at present undergoing the blowing and inflating process, we would here point a moral, and caution them to remember what happened to the poor frog when he attempted to attain greater dimensions than certain facts pertaining to his make-up would enable him to fill in safety.

FROGS CANNOT ATTAIN THE SIZE OF BULLS.

It does not follow that Kerite will forever keep silent because its voice has not been raised during the past year while "missionary work" and false representations have been entered into quite actively by some manufacturers and agents of other kinds of insulation.

Kerite has more life in it to-day than insulations which were unknown when it was born and which will have retired from active service before Kerite has passed its prime.

The increasing demand for a perfect and indestructible insulation for Telephone, Telegraph and Electric Light wires has caused many companies to purchase cheap and worthless material on the representation of experimentalists, who give a guarantee for a sufficient time to cover the short life of their goods. No insulation can be said to be perfect until it has been tested by years of use and exposure.

QUALITIES OF KERITE INSULATION.

It is proof against the corrosive elements in earth, air or water; the greatest extremes of heat and cold do not impair its flexibility, firmness or insulating properties. It will endure long-continued heat at 200° F., and, for short intervals, 250° to 300°, and may be safely immersed in boiling water. Acids act upon it very slowly. Strong solutions of alkalies do not injure it, and it is less affected by chemical re-agents, than any other insulating covering.

GUTTA-PERCHA IN THE OPEN AIR SOON BECOMES BRITTLE,

cracks and falls of; with exposure to the sun it softens, then cools, shrinks, cracks, dries and falls off, thus destroying insulation. India rubber, even when vulcanized, only partially escapes these difficulties, while Kerite is subject to none of these objections, and does not, like the preparations of gutta-percha, or vulcanized rubber, contain the elements of its own destruction. Mineral oils, illuminating gas, or the roots of plants do not affect it, and the action of water, salt or fresh, protects it and improves its insulation. The marine borers of southern and tropical seas, which destroy gutta-percha, do not attack it, it is proof against the heat of the tropics, which renders all other insulations useless, and against the ravages of white ants, which destroy gutta-percha. The qualities that render it indestructible by solar heat or corrosive agents, insure its durability in all climates, and while neither gutta percha nor vulcanized rubber will bear long storage without great and rapid deterioration, Kerite, under the same conditions, undergoes no change. The foregoing facts prove conclusively that for the covering of aerial, underground or submarine cables, or battery purposes,

KERITE IS THE MOST PERFECT, DURABLE AND ECONOMICAL INSULATION IN USE.

CABLES

The Armored Cables for river or harbor use are constructed by us on strictly scientific principles, and with the greatest possible skill known to the art. Careful electrical tests are made by competent electricians during each process of manufacture, and with all cables shipped we furnish a copy of the electrical tests made during their construction. Submarine cables, with Kerite insulation of our manufacture, are now in use in the service of the

WESTERN UNION, BALTIMORE & OHIO, POSTAL, UNITED LINES AND METROPOLITAN TELEGRAPH AND TELEPHONE COMPANIES,

and are giving perfect satisfaction. Special forms in actual use at various localities are shown in the various cuts in this catalogue.

The arrangement, or manner of "laying up," our aerial or underground cables, is such that any individual wire may be traced to any point in its length.

Proof of longer durability than any other insulation enables us to guarantee all goods of our manufacture when the requirements are known

The placing of electrical wires under ground is a contingency that must be provided for in most of our large cities, while in several places the construction of overhead lines has already been prohibited. No other insulation is so thoroughly adapted for this work, as has been proved by experience in numerous instances. The fact that Kerite cables are already being extensively ordered by the leading electrical companies for new underground work is substantial proof of their recognized merits.

The extra cost of both subterranean and submarine electrical construction, compared with aerial work, the expense and annoyance of repairs and reconstruction, all point to the supreme importance of using the best materials for such work, and prudent managers should carefully consider the point of durability, as well as that of first cost. No insulation used has so successfully encountered the various deleterious influences existing above and below ground or in the water as has Kerite, and wherever doubt exists as to the durability of insulation in certain locations, Kerite wire is always resorted to by electrical engineers of the longest experience.

The Attention of Electric Light Men is Called to the Following:

PROFESSOR J. P. BARRETT, CITY ELECTRICIAN OF CHICAGO, says that he put two Kerite wires underground in that city in 1875. Up to 1887 they have worked perfectly, no money having been expended on same for repairs.

PROFESSOR CHANDLER, OF COLUMBIA COLLEGE, says that Kerite possesses qualities as an insulator superior to those of gutta-percha or India rubber.

PROFESSOR MORTON, OF THE STEVENS INSTITUTE OF TECHNOLOGY, says that as an insulator for submarine, sub terranean and aerial cables, and for other electrical lines, Kerite is superior to any other.

M. E. LEVASSEUR, MEMBER OF THE FRENCH INSTITUTE, in his report to the French Government upon electrical exhibits at the Centennial Exhibition, said that Kerite was the best insulator within his knowledge. It was not injured under conditions which would destroy other insulators. He commended it to the attention of his government.

ADMIRAL PORTER, OF THE UNITED STATES NAVY, used Day's Kerite wire in exploding torpedoes His experience demonstrated that this insulation was more complete than that of the best gutta-percha covered wires.

MOSES G. FARMER, THE ELECTRICIAN, says that Kerite is a wonderful insulator—the best known.

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J. F. MORRISON, OF THE BRUSH ELECTRIC CO., OF BALTIMORE, SAYS: "Have tried and discarded all other insulated wires, and adopted Kerite. Two years' test shows maintenance far less, and accidents avoided. Our record excels any Electric Light Co. in the country, much of which I attribute to Kerite covered wire."

FOR SUBMARINE CABLES.

THE LATE PROFESSOR SAMUEL F. B. MORSE describes it as the most perfect of all insulators for submarine cables, successfully resisting causes of deterioration that destroy other insulators. It is an invaluable discovery.

THE LATE PROFESSOR SILLIMAN, OF YALE COLLEGE, said that Kerite is not only the best, but the most economical insulator in use for submarine cables and for general telegraphic purposes, and the least subject to destruction.

FOR TELEGRAPH WORK.

GEORGE B. SCOTT, Superintendent of the Gold and Stock Telegraph Company, says that Kerite is perfect and durable in submarine cables and all other lines where insulation is necessary. He has used it very extensively in submarine and aerial cables, and in office work. It is the best insulator known.

GEORGE B. PRESCOTT, ex-Vice-President of the Gold and Stock Telegraph Company, and late electrician of the Western Union Telegraph Company, says that a Kerite cable was perfect after many years' use under tests so severe that gutta-percha or India-rubber insulation would long before have been destroyed.

FOR TELEPHONE WORK.

GEORGE F. DURANT, VICE-PRESIDENT AND ELECTRICIAN OF THE BELL TELEPHONE COMPANY of Missouri, says that they have about 30 miles of Kerite wire on their private fire alarm, telephone, telegraph and other important signal wires. That its great durability and remarkable insulating properties have led them to consider its more extended use as a measure of economy.

TAPE.

KERITE TAPE is the only tape that has withstood the test of ten years or more of exposure. The necessity for making perfectly secure joints in an insulated wire is of the greatest importance; they should have proper protection, to prevent rust and oxidation Kerite is the only tape manufactured that will vulcanize by exposure, forming a perfectly water-tight sleeve over the joint A large number of spurious and worthless imitations have recently been placed upon the market, having no proof of long use or durability, all of which are sold for their adhesive or sticking qualities only.

WHAT THOS. D. LOCKWOOD SAYS ABOUT KERITE TAPE:—

"For Rubber or Kerite Cables it is requisite only to strip off the insulation from the required conductor at the ends to be spliced, and to brighten and thoroughly clean the copper, then to make a long and close twist, after the style of an office wire splice, after which the joint should be soldered and made smooth, and finally covered with good Kerite Tape. There is a very objectionable kind of tape which is now being liberally bought by persons who know nothing of the demands of good construction (company purchasing agents, et al.), simply because it is cheap, and which is sold with corresponding liberality, by dealers who do not care to possess the reputation of selling only good articles, because their customers ask for cheap grades. It will some day be found that in electrical construction only the best materials are cheap."

IN CONCLUSION.

The Electrical Supply Co,, 171 Randolph St., Chicago, carries in stock all sizes Kerite Wires and Cables; also Kerite Tape, in pound or quarter-pound rolls.

AMERICAN SYSTEM

—OF—

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

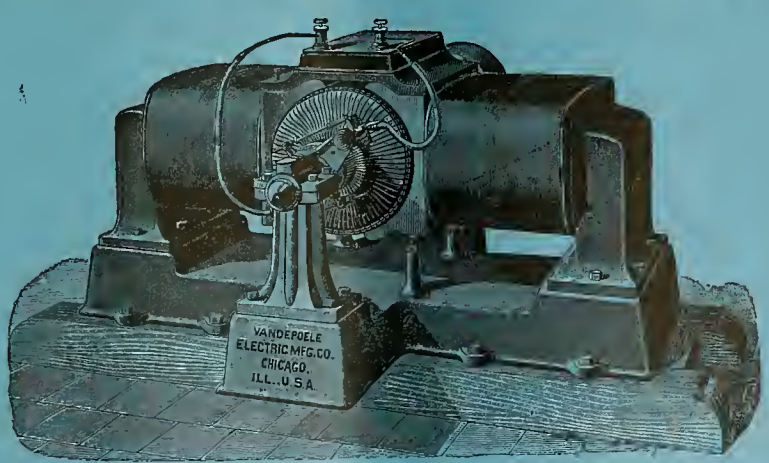
FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

VAN DEPOELE ELECTRIC LIGHT SYSTEM.

VAN DEPOELE
Double Carbon Lamp.



VAN DEPOELE
Single Carbon Lamp.

MUNICIPAL LIGHTING Our SPECIALTY.

☛ We claim for the Van Depoele Improved Arc Lamp that it is the simplest and best lamp in existence; for our Dynamos that they cannot get out of order, and require little or no attention; that an inexperienced man can run them, and that they give the most light for the least consumption of power.

Manufactured and for Sale only by

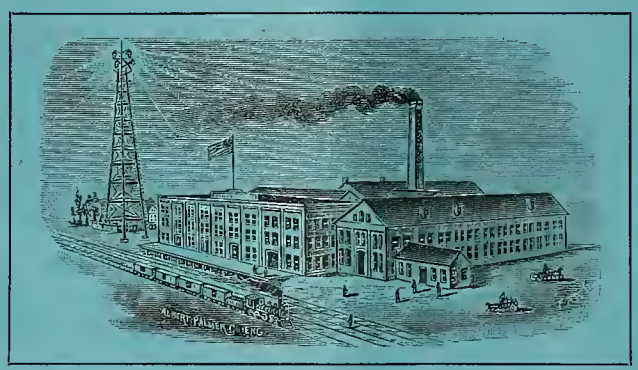
VAN DEPOELE ELECTRIC MANUFACTURING CO.,

15, 17, 19 and 21 N. Clinton St., - - CHICAGO, ILL.

FORT WAYNE

JENNEY ELECTRIC LIGHT CO.

Fort Wayne, Ind.



Fort Wayne, Ind.

MANUFACTURERS OF THE

SLATTERY INDUCTION SYSTEM

OF INCANDESCENT LIGHTING,

The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12--16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.

ALSO THE

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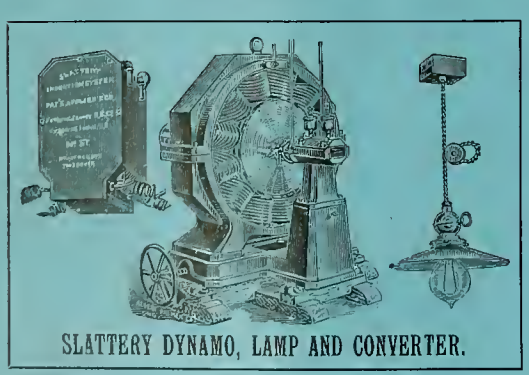
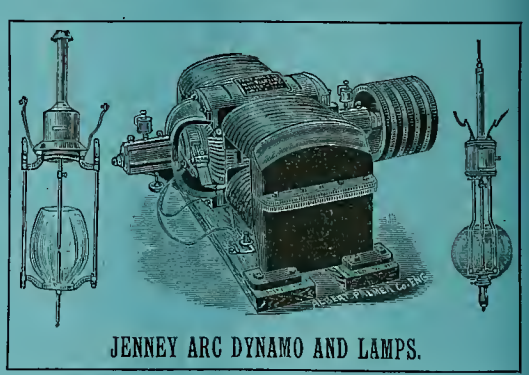


SLATTERY DYNAMO, LAMP AND CONVERTER.

CORRESPONDENCE SOLICITED.



JENNEY ARC DYNAMO AND LAMPS.

Main Office and Works, - FORT WAYNE, IND.

NEW YORK OFFICE, 242 & 244 EAST 122d STREET.

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CITY OF MEXICO OFFICE. F. Adams, Successor.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. III. CHICAGO, AUGUST 4, 1888. No. 5

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Electric Light Globes, Shades,

—ETC.—

SEND FOR CATALOGUE AND PRICE LIST.

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General Offices, No. 708 PENN. AVE., PITTSBURGH, PA.

Branch Offices: { New York, Telephone Building, Cortlandt Street, G. L. Wiley Manager. Chicago, 139 East Madison Street, F. E. Degenhardt, Manager.

MANUFACTURERS OF

The Waring Anti-Induction and Bunched Cables

For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial.

LIGHT LEADED CABLES FOR HOUSE USE.

Weatherproof Line Wire, Underwriters', Annunciator and Office Wire,

Five Years of Uniform Success Enable us to Guarantee our Cables.

DAY'S KERITE INSULATION.

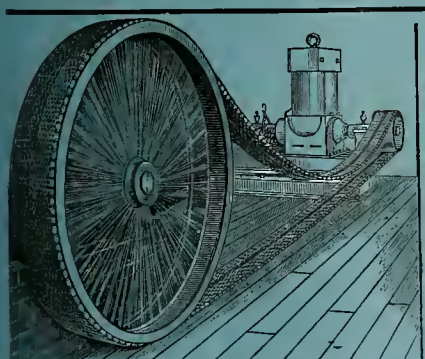
The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power. Telegraph and Telephone. Railway and all other Branches of Signaling.

All Sizes *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

CLARK B. HOTCHKISS, Gen'l Mgr., - 16 Dey St., NEW YORK.



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Leather Link Belt Co.

SPECIAL

DYNAMO BELT!

CHAS. A. SCHIEREN & CO.

Manufacturers and Sole Agents,

47-51 Ferry St., New York.

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APPARATUS OF EVERY DESCRIPTION.

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—MANUFACTURERS OF—

BITITE and TRINIDAD

INSULATED WIRES AND CABLES.

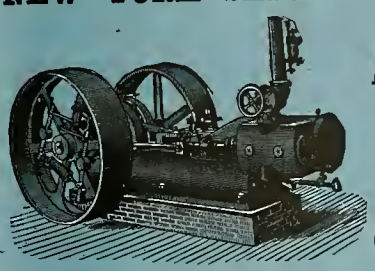
Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

TRINIDAD WIRES for Line Work in place of Underwriters.

ELECTRIC LIGHT WIRES of all sizes a SPECIALTY

NEW YORK SAFETY STEAM POWER CO.,

Builders of High Grade Self-Contained



Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

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And other duty requiring close regulation of speed.

WESTERN OFFICE AND WAREROOMS:

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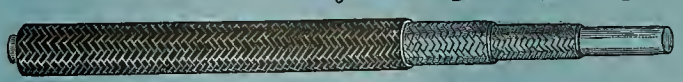
ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A



CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his

Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

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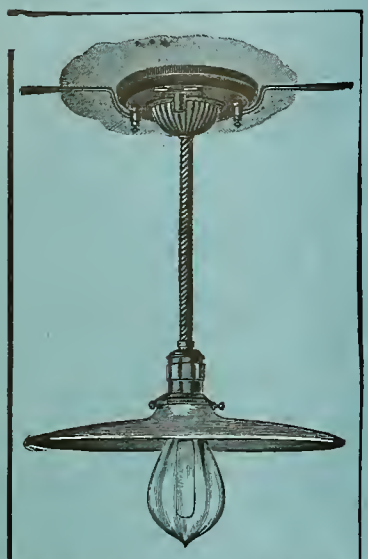
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



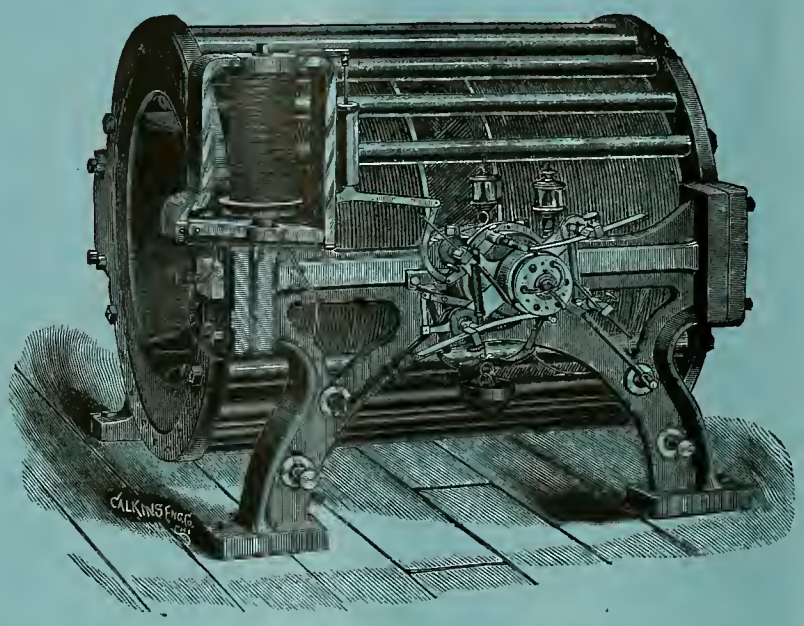
SERIES LAMPS

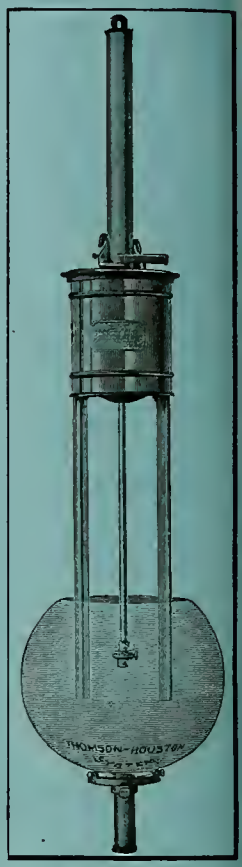
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



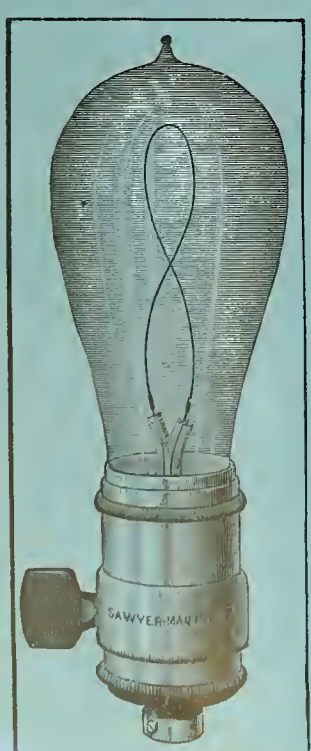


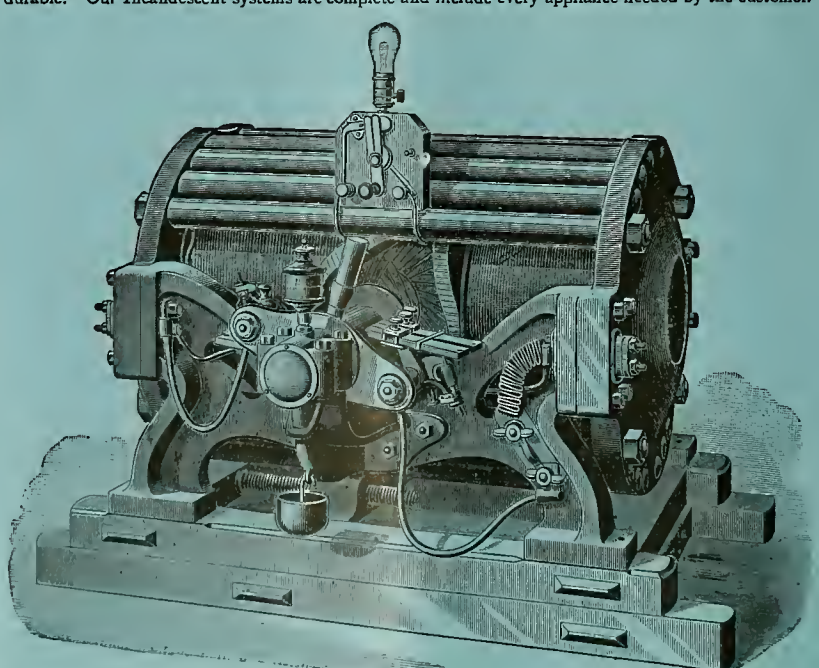
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

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As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,
16 & 18 BROAD STREET, NEW YORK.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{50}{100}$ per H. P.
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ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

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WE CARRY A FULL STOCK OF J. H. BUNNELL & CO.'S TELEGRAPH INSTRUMENTS.

Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

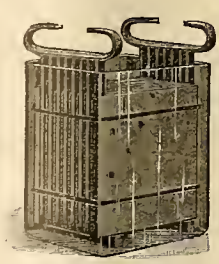
ELECTRICAL ACCUMULATORS or STORAGE BATTERIES,

Especially Adapted to

CENTRAL STATION LIGHTING,

Isolated Lighting, Railroad Car Lighting,

Street Car Propulsion, Long Distance Lighting.



Among the Advantages of this System are:

Absolute Certainty of Light,
Increased Life of Lamps,
Great Economy of Running Expenses,
Absolute Steadiness of Current,
Utilization of Surplus Power,
Adaptability to Existing Plants,

And Complete Displacement of Gas.

Inquiries from NORTHERN ILLINOIS, EASTERN IOWA, WISCONSIN and MINNESOTA should be addressed to the exclusive licensees for said territory,

Northwestern Electrical Accumulator Company,
223 PHENIX BUILDING, CHICAGO, ILL.

Inquiries from other Territory should be sent to

The Electrical Accumulator Company,
44 BROADWAY, NEW YORK.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

JARVIS ENGINEERING COMPANY,

61 OLIVER ST. BOSTON. | 81 LAKE ST., CHICAGO. | 109 LIBERTY ST. NEW YORK.

H. A. CLASIER. Manager Western Dept.

CONTRACTING ENGINEERS FOR ERECTING COMPLETE STEAM PLANTS FOR

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NATIONAL FEED WATER HEATER,
JARVIS BOILER SETTING, to burn Anthracite Coal and Coke Screenings
NATIONAL ROCKING and SHEFFIELD GRATE BARS.

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THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

B. D. BRAIDED WIRE.

THE POPULAR WIRE FOR INCANDESCENT WORK.

Safe and Reliable.

NEW YORK INSULATED WIRE CO.,

11 Central St., Boston, Mass. 452 Broadway, New York.

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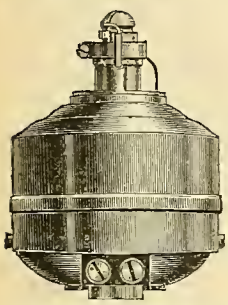

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1018 Chestnut St., Philadelphia, Pa.

'Improved' Automatic Burner.

On the Automatic Burners the electricity not only lights the gas, but turns it on and off by means of the push buttons, or keys. The Automatic has been greatly improved, and is fitted with binding posts, instead of the loose wires, as formerly, and new form of shell.

The improved Automatic and Pendant Burners are guaranteed to be reliable, safe, and of first-class workmanship.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
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Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

SPRAGUE RAILWAY WORK.

Roads in Operation or in Process of Construction July 14, 1888.

Richmond, Va.	40 cars.	Davenport, Iowa	8 cars
Richmond Extension	50 "	Salem, Mass.	6 "
Carbondale, Pa.	3 "	Brockton, "	4 "
Wilkesbarre, Pa.	4 "	Hartford, Conn.	2 "
St. Joseph, Mo.	8 "	Scranton, Pa.	20 "
Wilmington, Del.	3 "	Steubenville, Ohio	6 "
Harrisburgh, Pa.	6 "	Manchester, Va.	10 "
Lafayette, Ind.	9 "	Akron, Ohio	12 "

February 1st not a Road in Commercial Operation, To-day Consult the Above Record.

SPRAGUE ELECTRIC RAILWAY AND MOTOR CO.,

16 and 18 BROAD STREET, NEW YORK.

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THE WOODWARD ELECTRICAL COMPANY,

MANUFACTURERS OF THE

For Light and Power Purposes.

DETROIT STORAGE BATTERY

For Light and Power Purposes.

Estimates for furnishing plants can be had on application to

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Offices, 69 Griswold St, CAMPAU BUILDING.
Factory, Corner 13th and Woodbridge Sts.

DETROIT, MICH.

BAKER'S TRIPOLINE!

A Powerful and Rapid Cleaner and Polisher of Metals without Acid or Poison.
Especially Adapted to Railroad, Marine, Stationary and Fire Engine Work, "hot or cold;" Large Signs, Railings, etc.

This polish is now being supplied to Hundreds of Mechanical Engineers **ELECTRIC LIGHT PLANTS**, and manufacturers of Machinery. Has already been adopted by many of the leading railroad companies, the leading fire departments, water works, the U. S. Ordnance and Navy Departments, and thousands of Mills, Factories, etc. Is the BEST AND CHEAPEST POLISH IN THE WORLD, and quickest Cleaner. **Unequaled for Cleaning and Polishing Carbon Holders.** Send for Sample, FREE. Liberal discount to manufacturers and dealers in **Electrical Machinery.** Manufactured only by the

MATCHLESS METAL POLISH CO., - - 88 MARKET ST., CHICAGO, ILL.

NEW PATENT GAS ATTACHMENT

FOR FITTING ELECTRIC LIGHT SOCKETS TO GAS FIXTURES.

No more burnt wire conductors where this attachment is used.

Remove gas burner, screw nozzle in its place; by replacing and screwing gas burner on nozzle, you effect a solid, permanent, gas tight job. Send orders to

FRANK S. MARR, Contractor.
Bissell Block, PITTSBURGH, PA.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD WILKINS.

ESTABLISHED 1867.

PARTRICK & CARTER,

MANUFACTURERS OF AND DEALERS IN EVERY DESCRIPTION OF

ELECTRICAL SUPPLIES.

SOLE PROPRIETORS OF THE
PATENT NEEDLE ANNUNCIATORS AND BURGLAR ALARMS.
WE MAKE A SPECIALTY OF
BELLS, DISQUE LECLANCHE BATTERIES, GAS-LIGHTING APPARATUS
AND A FULL LINE OF
SUPPLIES FOR ELECTRIC BELL WORK.

We publish Catalogues of all our Manufactures, and will forward to any address upon application.

N. B.—When applying for Catalogues, please state whether "Electric Bell" or "General Supply" Catalogue is wanted, and if in the trade inclose business card for discounts.

114 South Second Street. PHILADELPHIA, PA.

Use Marks' Compound Wire for Battery Coppers.

High Insulation

In order to meet the constantly increasing demands for

BETTER INSULATION,

THE BISHOP GUTTA-PERCHA CO.

420-426 EAST 25th STREET, NEW YORK CITY,

HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

FOR MAKING THE CELEBRATED

HOOPER'S CORE

AND OTHER RUBBER COMPOUNDS

FOR INSULATING WIRES FOR

Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

HENRY A. REED, Manager.

USE NOTHING BUT

GUTTA-PERCHA FOR SUBMARINE CABLES.

Use Balata Insulation for Flexible Cords.

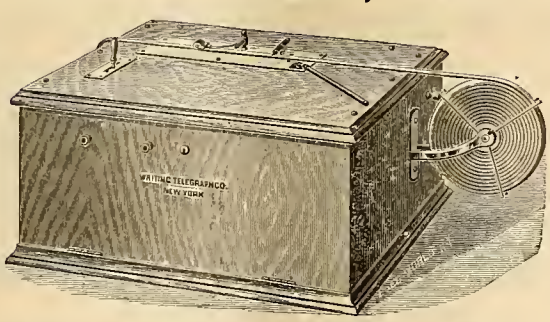
WRITING TELEGRAPH COMPANY,

57 MURRAY STREET, NEW YORK.

This Company owns the Letters Patent which thoroughly control the transmission of written messages by telegraph in the only known practical way, and are prepared to establish Central Office Exchanges as a means of communication between subscribers in cities and surrounding towns.

Communications are written with pen and ink in the handwriting of the person writing the message.

For particulars address



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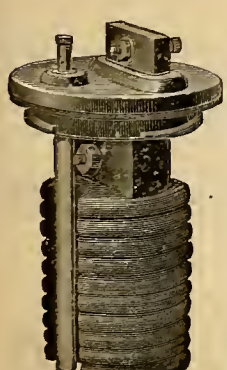

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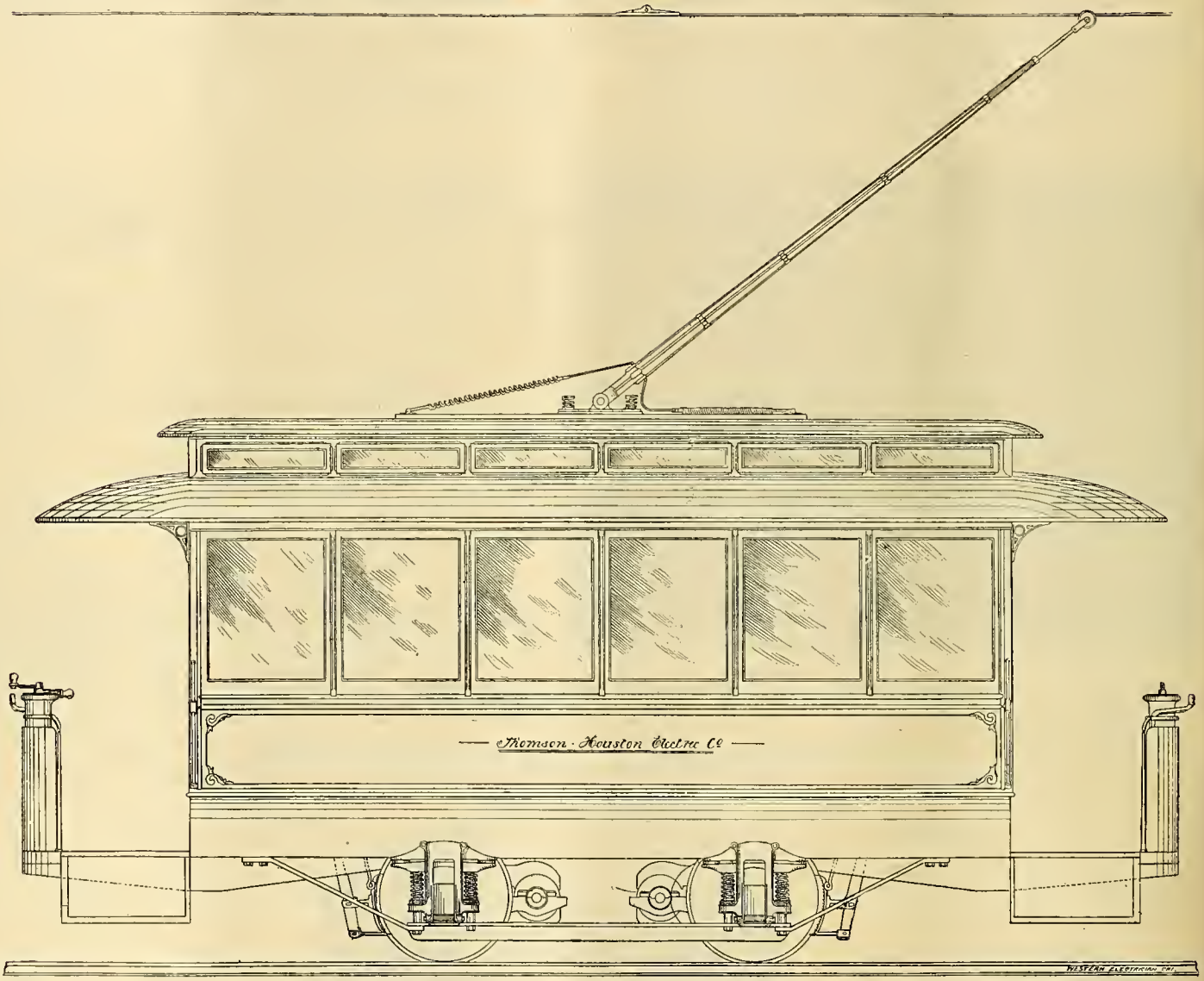

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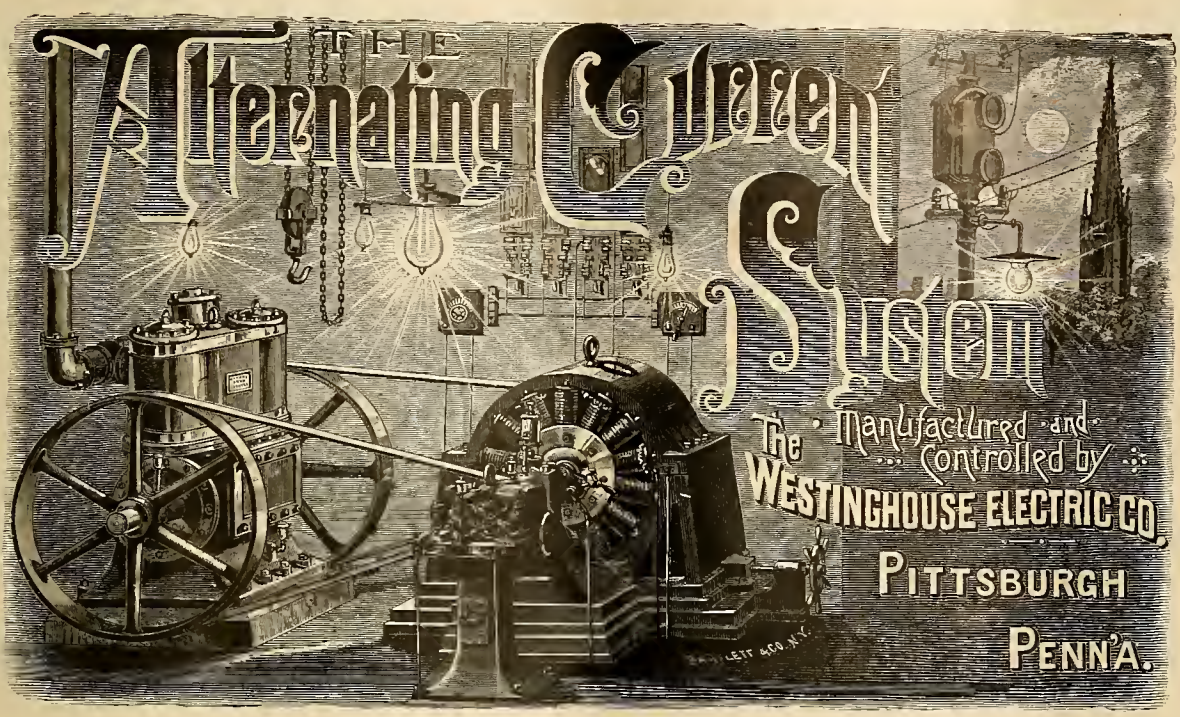

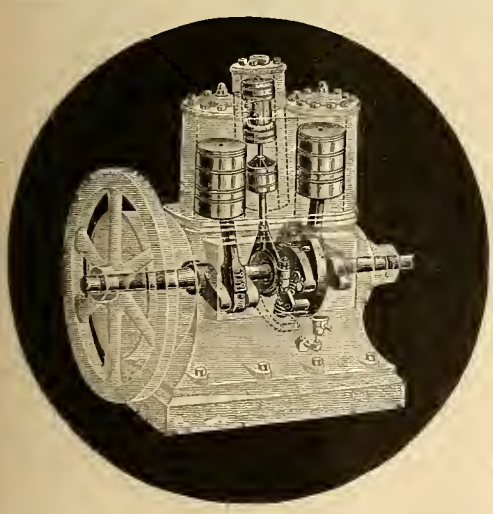

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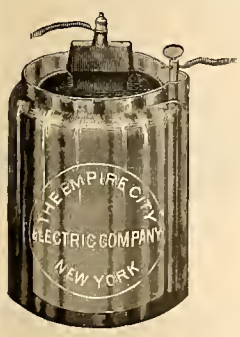

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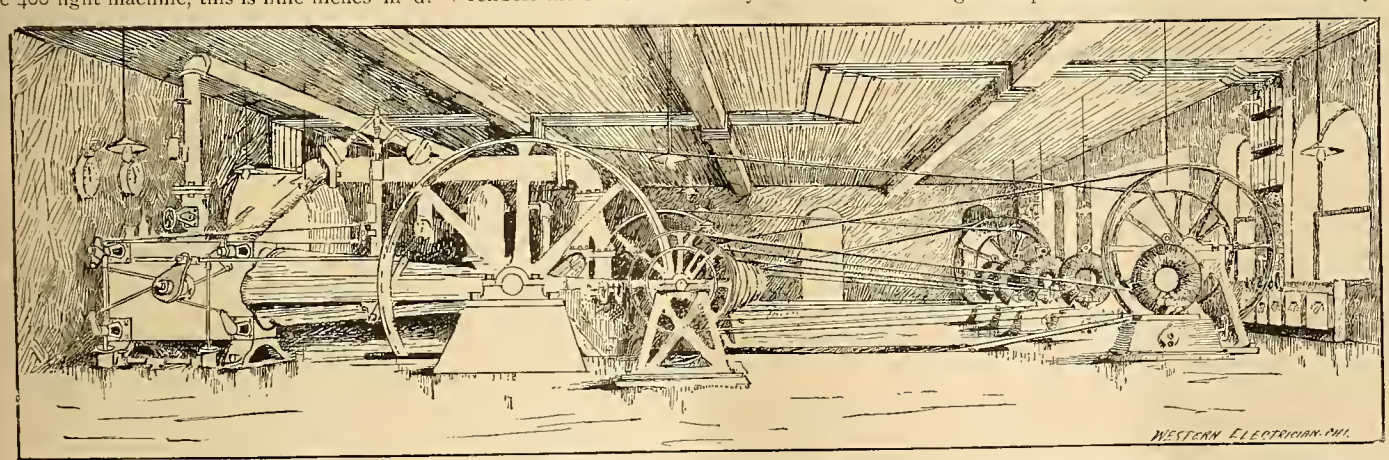
Vol. III. CHICAGO, AUGUST 4, 1888. No. 5.

Mather Plant in Hotel del Coronado.

Away on the southwestern Pacific slope at Coronado Beach, California, stands a remarkable building known as the Hotel del Coronado, one of the finest hotel buildings, considering its distance from any of the great centers of travel or population, in the world. A million dollars, it is said, have been invested in it in order to provide luxury loving visitors from colder climes everything that could be desired in a hotel.

One of the most interesting features of the place is the incandescent electric light installation. On the northern shore of Glorietta bay, just south of the hotel, is the two-story brick laundry and engine house, in the basement of which are placed the dynamos, together with the heavy pumping and heating machinery of the hotel. In an addition are the two Hazelton boilers. The dynamos are of the Mather type and are five in number, two having a capacity of 400 lights each, and the three others each having a capacity of 250 lights. The machines appear to be the simplest dynamos for general efficiency made. The field magnets are of horseshoe form, curving down until they almost completely envelop the sides of the armature. In the 400 light machine, this is nine inches in diameter by twenty-two inches in length and is run at 1,300 revolutions per minute, consuming about 40 horse power. Although each machine is not over 60 inches in height and apparently of light construction, it weighs nearly two and one-fourth tons.



The heavy and doubly insulated copper wires leading from the five dynamos terminate in a large switchboard that occupies the entire space between two windows in the engine room. This board is so arranged that a person standing before it can control every circuit throughout the hotel building. Near the floor are five controllers, one for each dynamo, by means of which the candle power of the lamps is regulated. Above this is the switchboard proper, where the current from either or all of the dynamos may be thrown on either or all of the five floors of the structure, and either in series or in multiple. The positive and negative wires are marked and are amply provided with safety fuses that will melt and break the current of either machine in event it becomes too great through short circuiting or other means. The arrangement for testing is also perfect, and any short circuit can be located on either the positive or negative wire by simply turning a switch lever opposite each wire and watching the effect upon a lamp that overhangs the board. Above this are the voltmeters and ammeters that show the pressure and quantity of current respectively from each dynamo. One beauty of the system of wiring is that it is the same in every part of the plant, hence it is easy to locate a wire, no matter in what portion of the building it may be found.

The dynamos are made automatic, or self-regulating, that is, their currents are regulated according to the number of lamps that are burning. One of the 400 light dynamos will thus operate one lamp or 400 lamps with equal efficiency. The lamps used are 16 candle power and are of the Perkins type. There are 2,500 lamps in the entire building.

From the engine room the wires, twenty in number, are led along the roof of the tunnel to the basement of the hotel under the breakfast room. After they leave the tunnel they are concealed inside moldings and floors and ceilings, not an inch being visible. Following along the roof of the basement, the wires are led up the southeastern corner of the court to the floors above, where they branch off at every story and hallway until they reach every room in the building. Each lamp is protected with a fusible plug, which not only protects the lamp but renders the current absolutely safe. There are but two switchboards in the entire hotel building. The larger one is placed on a wall in the carving room and controls the lights in the carving room, dining room, breakfast room, kitchen, and bakery. By turning one key all the lights are extinguished; another, and those in the dining and breakfast rooms are put out; still another and every other light of those remaining is extinguished. As in the other portions of the building, the circuits are amply protected by means of safety fuses. There are 103 lights on brackets in the dining room.

In the office is another similar switchboard, controlling the lights in the adjacent rooms. With the gallery lights and the imposing chandelier, the office presents a most brilliant appearance. About 100 lights illuminate the theater and ball room, and the electric footlights are provided with a "step-by-step" switch, by means of which the lamps are made to give any desired amount of light from a glow to a glare.

The whole incandescent plant was installed under the supervision of W. M. Thomas, an electrician of the Chicago office of the Mather company, J. H. Reid, manager.

The South Side Electric Light & Power company of Chicago has been incorporated; capital stock, $500,000. The incorporators are H. V. Harris, James Hood and Frank Butterworth.

Chicago City Electric Light.

Professor Barrett, city electrician of Chicago, said recently of the economy of the operation of the new electric light plant by the city: "The financial part of the experiment is satisfactory, I think. If a corporation can set up in business, put in a big plant at a great cost, and pay big dividends, I do not see why the city cannot make it pay. It can certainly buy material as cheaply as anybody, and it does not have to pay taxes or insurance or rent. I'll concede that labor always costs a municipality a little more than a private corporation, but look at the margin from the other conditions to draw against. I'd be well satisfied if the city would give me what the plant will save on the gas lights displaced—that will run the department right along and make it self-supporting. It's a singular fact, but the more electric lights there are—street lights, I mean—the more gas is burned. The gas companies lose by the displacement of their street lights, but more than make it up on the private consumption. For instance, when a store is lighted by electricity, the merchant next door feels in the dark and lights up six gas jets where he formerly burned but one or two. I told the gas companies that would be the case two years ago, but they were skeptical. Now they are finding that I was right, and in consequence they are not kicking at all."

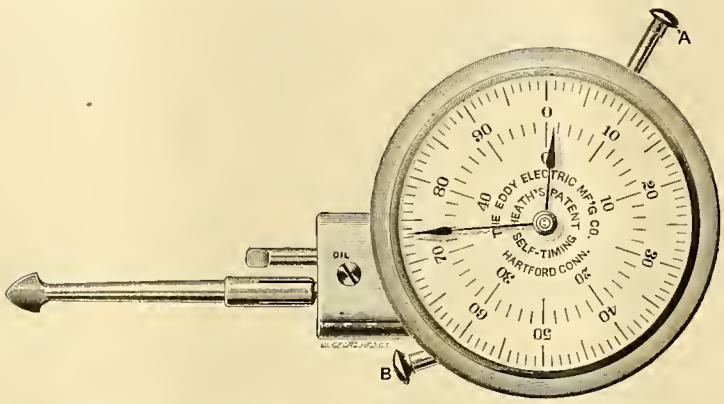
Vestibuled Electric Cars.

The Thomson-Houston Electric company of Chicago has commenced the construction of the ten miles of electric street railway which will connect Council Bluffs and Omaha. It is expected that twenty cars will be in operation by October 1st. Each motor car will draw an additional car and the two cars will be vestibuled. It is believed that they will form the first vestibuled street railroad trains in the United States and probably in the world. The company has bridged the Missouri at a cost of $300,000. The Union Pacific now carries between the two cities about 1,000,000 passengers annually. As the fare on the electric railway will be reduced the company expect to get most of these passengers, and the number of persons carried yearly will be, it is estimated, about 1,500,000. The company is already considering the advisability of constructing an extension of fourteen miles. The fact that the trains are to be vestibuled will, it is thought, make the road popular as well as attract to it the attention of street railway managers in all parts of the country.

Heath's Self-Timing Speed Indicator.

The accompanying cut illustrates a self-timing speed indicator. The cut is the full size of the instrument. The object which the inventor desired to attain was the perfection of a speed indicator, which would be self-timing, self-registering and adapted to the highest as well as the lowest velocities. Three distinct mechanisms which can be combined at will, contribute to the attainment of these ends. The peculiar features are noticed in the following description:

First. The transmitting device consists of the detachable point shown at the left of the cut. This point is lance shaped at one end and



is provided with a socket at the other. Two strong pinions running together and each having a projecting shank, fit the point socket, so that a shaft running in either direction may be timed by attaching the point to the corresponding pinion. A pinion box holds these parts in proper relation to each other, and with the body of the instrument.

Second. The counting and registering apparatus consists of a worm and gear with which are connected the hands, each being provided with a heart cam as in the case of a "fly-back" watch. There also necessary motion wheels and pinions to secure the proper relative motion of the hands.

Third. The time mechanism includes a strong lever escapement absolutely non-magnetic which is operated by a spring attached to the power wheel and this receives the same impulse whether the speed being taken is high or low. The parts of the instrument are held between plates in a manner similar to those of a watch and are inclosed in a neat and substantial case.

In using the indicator the setting pin A is firmly pressed inward until it stops, which sets the hands at O and winds the power spring. Then the point being attached as in the cut, or in case the shaft runs in the direction followed by the hands of a clock, to the upper pinion, the point is placed in the center of the shaft to be timed, brought as nearly as possible in line with it and held with enough firmness to prevent slipping.

The starting pin B is then pressed firmly inward and released; this starts the hands and at the same time releases the time train. The instrument must now be held steadily in place until the hands stop when the rate of speed may be read on the dial, the outer graduated circle indicating revolutions and the inner one hundreds of revolutions. These instruments are manufactured by the Eddy Electric Manufacturing company of Windsor, Conn.

Chicago Electric Club.

A meeting of the officers and managers of the Chicago Electric club was held July 30. It was voted to discontinue literary meetings till the first Monday in October. This committee was appointed to consider the question of new quarters: S. A. Barton, C. A. Brown, B. E. Sunny, C. D. Shain and H. Ward Leonard. It was voted to expend no more money on club rooms till the question of location was permanently settled. President Barton spoke at length of the advisability of establishing an exchange similar to the New England exchange of Boston, and the following committee was appointed to consider the matter: B. E. Sunny, C. A. Brown, C. D. Shain, J. P. Barrett, F. W. Horne.

Motor for Horse Cleaning.

A new and curious employment of motors of small powers is found almost daily. These novel uses go to show how far reaching is the application of electricity. The cut in this connection illustrates the use of a Sprague motor for the commonplace work of horse cleaning. It is used in the Des Moines Street Railway company's barn in connection with a Wells machine for cleaning horses. Two installations of this kind have been made there. It is claimed that by this means two men can accomplish as much work as six by the old-fashioned hand process. With a street car company this saving forms a considerable item in the course of a year. Whether the motor appeals to the intelligence of the horse or not it is certainly asserted by good authority that the animals demean themselves much better than when attacked by the old hand process. The installation was made by H. O. Woodruff, agent of the Sprague company at Des Moines.

Sperry Electric Company.

The majority of the stock of the Sperry Electric company of Chicago, has been placed, through the energy of Geo. H. Bliss, and the corporation proposes to begin active operations at once. The controlling interest in the company is held by Samuel P. Parmly, D. P. Perry and E. E. Crepin. These gentlemen are possessed of large means and will put the company on a sound financial basis. The capital stock of the company is $250,000. The officers are: President, Samuel P. Parmly; vice-president, D. P. Perry; secretary, George H. Bliss; treasurer, E. E. Crepin; electrician, E. A. Sperry. The company will manufacture apparatus in the Springer building on Clinton street, near Van Buren street.

Auditorium Electric Plant.

Editor WESTERN ELECTRICIAN:

CHICAGO, July 26.—In your article on the Auditorium plant in issue of July 28, 1888, you seem to infer that the reason the United States company did not accept the contract for the Auditorium lighting was on account of what you say was a condition of contract, viz.: "A guarantee of 12-16 candle-power lamps to the horse-power, and 1,000 hours' life for the lamps." We wish to correct you in this, and say that such is not the case. The executive committee of the Auditorium were very fair and impartial in awarding this contract, and gave the United States company the first refusal of one of the plants. This was because the bid of the United States company was the best in every respect, showing greater efficiency and economy of operation than other bids. The reason the United States company did not accept the contract was on account of the terms of payment, which were not satisfactory to our company.

Yours respectfully,
C. C. WARREN, Manager,
Pr. SHAIN.

[We have carefully re-read our article on the Auditorium plant, and we do not think by any fair construction the inference can be drawn from it, that the United States company declined their part of the contract on account of the required guarantees. There was certainly no intention on our part of intimating anything of the kind, because it was perfectly well understood that the United States company were ready to stand by their guarantees and to give a heavy bond for the execution of their contract, had they accepted it.—ED.]

Telephones in Sweden.

Editor WESTERN ELECTRICIAN:

BOSTON, July 24, 1888. The last item in your column of telephone notes in your issue of July 21st, gives in substance the statements of one Jonas Vestrom about telephone service in Sweden, which statements you rightly class as extraordinary. I do not know where, or to whom Mr. Vestrom has been talking, but if he is correctly reported, he could give points to Ananias, Munchausen, or to Ferdinand Mendez Pinto. His statements would not be worth noticing except for the reason that an erroneous statement flies fast and far while a statement of fact is getting its boots on. The item states that "Orebro" is a place of 40,000 inhabitants. "Lippincott's Gazetteer" says 10,000. The item states that "in the city of Stockholm there are 7,000 telephones in use, and every subscriber owns an instrument."

The last published statistics on the subject, viz., the official "Bulletin Internationale de l'Electricite," says there are in all Sweden 5,705 telephone subscribers, of which 3,825 were in Stockholm. It is a fact that only one city in the world has 7,000 telephone subscribers, and that is New York.

In Sweden there are several parties in the telephone business. First—the state; second—five companies; third (and this in the smaller towns)—certain mutual associations of the subscribers themselves.

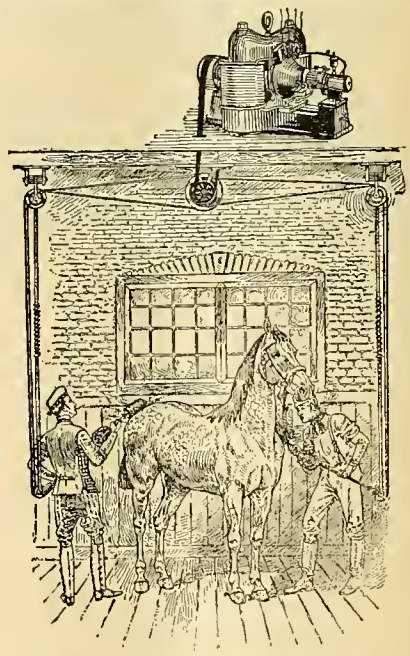
The latter is probably the slight basework of fact upon which Mr. Vestrom has built his story, since Orebro does not appear at all in the list of cities having telephone exchanges, which are sixteen in number. The highest annual subscription paid in Sweden in exchanges officially recognized is 173 francs and 50 centimes. The lowest is 69 francs and 50 centimes, plus a charge for original installation of 250 francs. This is the rate at Gotheborg.

THOMAS D. LOCKWOOD.

Suggestions for the Board of Electrical Control.

Editor WESTERN ELECTRICIAN:

CHICAGO, July 27.—I have noted with great interest the debate now in progress in New York before the Board of Electrical Control of that city. There seem to be points on both sides which no one can refute. Under normal conditions the high tension currents can be rendered harmless; this I think has been clearly shown in the discussions, but under normal conditions, such for instance as grounded circuits, this does not obtain, and these circuits then become an element of great danger. However, since there is now upon the market apparatus by means of which these circuits even in their abnormal conditions are rendered automatically and instantaneously harmless, why not follow out Mr. Peck's suggestion and have the Board of Electrical Control "control" these matters to such an extent that the use of these devices be insisted upon in such a way that even when the circuits are in abnormal condition they will be still rendered perfectly harmless? The switch which the



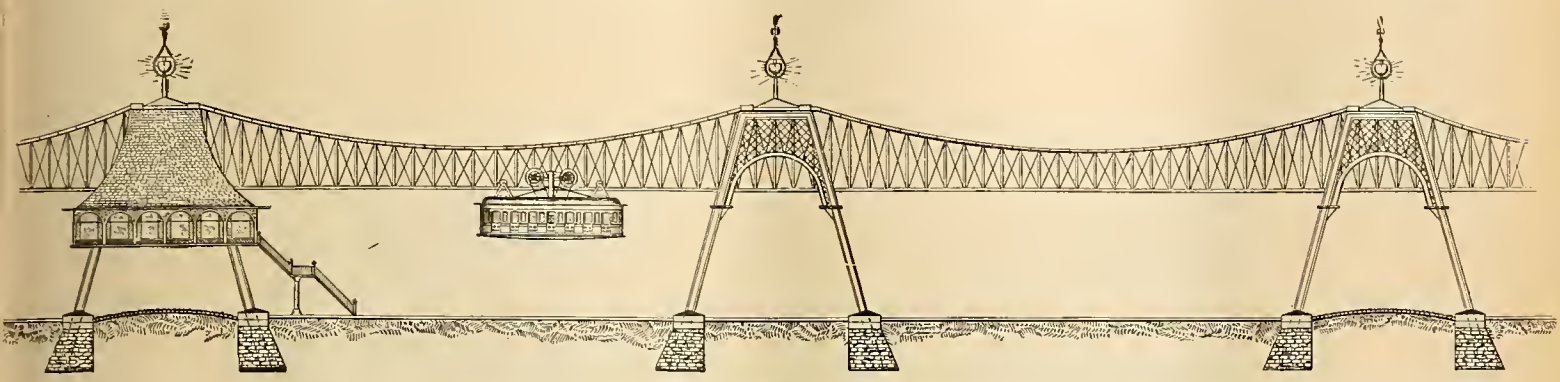
Electrical Supply company has recently placed upon the market has been subjected to an exhaustive series of tests showing conclusively that any grounded loop upon a circuit severed from the main circuit, the main circuit being thrown to a new loop on which there is no ground, even before such ground is fully developed and before the same can become dangerous in the least degree. In the course of these experiments many new uses of this device have been developed, such for instance, as charging storage cells from circuits when the storage cells are permanently connected with service wires upon fixtures, which wires are liable to be grounded. The main circuit connection with the battery is automatically severed before a ground of any magnitude has been developed. The Board of Electrical Control could not do better than to stimulate the use of devices already upon the market, which will insure immunity from danger to life and property, which it seems is the great desideratum as brought forth in the discussion.

E. A. SPERRY.

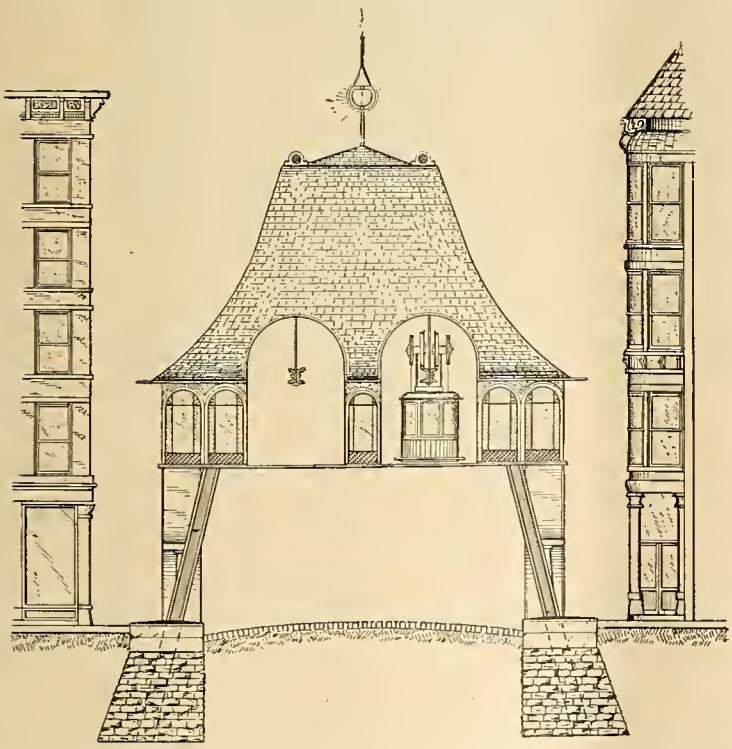
Forsyth's Elevated Suspension Railway.

R. Clark Forsyth is the inventor of one of the latest schemes for transporting passengers intermurally. He has just opened an office in Chicago, to introduce his system and build all the lines he may have contracts for. This new railway has features peculiarly its own; it affords another chance for electric propulsion particularly. Fig 1 speaks for itself. Fig. 2 (the lower one) shows the station entrances, with car coming in.

The invention is principally designed for use with light cars in high speed transit for street



service, and for the transmission between cities of express packages, mail matter and similar freight. It consists essentially of two parallel cables braced and tied together, extending from the top of and between, open arched piers. From these cables there is suspended by suitable ties and struts a road girder upon which is secured the track rail from which the car suspends. These girders are formed of two channel beams, arranged back to back and secured rigidly together by castings and rivets or bolts, the castings being of such shape as to allow the beams to lie within recesses formed by the side projecting ends of the castings, and thus relieve



the shearing strain on the rivets. These beams break joints with each other, and, riveted together, form a stiff girder, capable of taking considerable lateral as well as downwardly deflecting strain. Upon the upper flange of each of these channel beams, rails of ordinary form are secured by inverse cone headed bolts sunken into their surfaces, so as to form a continuous track.

It is designed to have stations at suitable intervals along the road for local traffic. These stations may be provided for between the double arches at the street intersections; stations for up travel being on one side of the arch, and stations for down travel being upon the other, and each provided with stairs upon which to ascend from, or descend to, the sidewalk below. It will be noiseless in its operation, the speed will be from 15 to 20 miles between stations, and the cost of construction is calculated to be from $50,000 to $60,000 per mile, double track.

A rigid steel casting sustains the floor beams of the car, and rising through the roof spans the roadway, and attaches to truck, carrying frames suitably provided with springs and sustained on flanged wheels mounted upon the rails on the top flanges of the channel beams, each on its respective side. Boxes are provided on these trucks in which are journaled shafts, on one end of which is carried the flanged driving wheel and upon the other a double flanged pulley, two of these pulleys being upon each side of the track. These pulleys may be actuated by belts, driven by any suitable motor situate within the car.

It is deemed best to suspend an electric conductor from the roadway between the beams and take off therefrom current to supply electric motors. The form of conduit preferred has an outside metallic casing, slotted at the bottom to admit of a bar, projecting upwardly and into it. Within this casing, a copper tube, or other good conductor of electricity is placed, insulated from the outside casing in any of the usual methods. A brush of wire is arranged to be carried by the bar, and to receive the electric current from the conductor. From this brush the current may be carried to an electric motor placed within the car, and thus propel it through the belts and drivers.

The base plate carries standards, in which are axled flanged wheels, free to roll upon the track rail. Side play is thus given the truck with its wheels, and it is free to move laterally to accommodate itself to the varying line on the track.

This describes the invention as applied to a double track road having traffic in opposite directions. The double cable system of suspension is equally applicable to a single roadway.

Telegraphers' Trials.

A telegraph operator recently gave utterance to some of the trials which beset his lot. He said: "A first-class operator frequently starts out as a 'messenger,' and through his own perseverance gradually learns the 'ropes,' and, if he is ambitious enough, he finally becomes an operator. He may not then be fully up to the standard. He's got to become accustomed to different styles of messages, such as 'social business' and 'cipher.' Any first-class operator can sit down and write cipher after cipher, with the experience he has had with the economic and costly style of telegraphing. For instance, in an everyday style like this: 'How melons ripe enough to pluck?' or 'Cotton's easier, market steadier, cotton coming in lively,' is all easy enough, but when the message gets this way, 'Somnambulistic echu, buy hundred bales middling,' and it is mixed up at the other end to read, 'summon an ambulance, try hounded pills, middling, etc.' or 'send me firfzig tollar, I vaf ousgaspeilt,' it is not quite so easy. The operator looks at such a message, turns it different ways and either carries it back for 'reconstruction,' or lets it go as written. Then again, 'I wasn't yez coom right doon on the wire,' no doubt means, wants him to reply by wire. When he gets such a message the operator is in another 'pickle' what to do.

"In 'cipher' and 'cables,' though,such risks cannot be taken, as it might involve thousands of dollars, and as the operator's finances are nominal, he cannot take the risk.

"There are also stock quotations that are important, oftentimes more so than the cipher messages. A quotation comes along. The merchant does not intend to invest until he is certain that the quotation has been correctly received. An operator or the telegraph company cannot always be held responsible for misspelled or badly written messages."

"How should a message be written to insure prompt dispatch and quick delivery?"

"It should first be plainly written, every word and figure spelled out. Paper is plentiful and can be generously utilized for this important purpose."

Cleveland Electric Road.

The contract for equipping the Euclid Avenue railway in Cleveland with electric motors, has been awarded to the Sprague Electric Railway & Motor company. This is a new road which will be about four miles in length, running as far as the Garfield monument. The company will supply motors for small powers along the road. The road will be in operation with sixteen cars by October 1st.

The dogs in the pound in New York are to be killed by electricity without waiting for the new law as to capital punishment to go into effect. Schuyler S. Wheeler, the electrical expert of the board of electrical control, has suggested procuring a gas engine, a dynamo and a hopper somewhat similar to the top of an old-fashioned coffee mill. Two sides of the hopper will be of zinc or other highly conductive material, and the two poles of the circuit will be attached to them. Then the dogs can be dropped in the hopper, and as they come in contact with both zinc plates the circuit will be completed and the animals receive their death shock. Mr. Wheeler says 300 volts of electricity will probably suffice to kill a dog, but he has recommended using 1,000 volts so as to insure success.

The Solution of Municipal Rapid Transit [1]

By Frank J. Sprague.

PART III.

For thirty cars running on a double track the central station expenses are about as follows:

52 42-100 cwt. coal, at 10 cents	$5.84
113 70-100 cwt. screenings, at 7 cents	7.96
5 pints cylinder oil, at 75 cents per gal	.47
5 pints dynamo oil, at 30 cents per gal	.18
3 pounds waste, at 10 cents	.30
Water at current rates	3.00
Fuel, etc	$17.75
1 day engineer	$3.00
1 night engineer	2.25
4 firemen	6.00
1 cleaner	1.50
2 dynamo men	3.50
1 electrician	4.00
Labor	$20.25
Lighting	.50
Depreciation and repairs on dynamos, 3 per cent	1.50
Depreciation and repairs on engine and boilers, 10 per cent	4.38
Total central station expenses	$44.38

Or $1.48 per car making 80 miles.

[The central station being operated for twenty-four hours for lighting and power purposes, the lighting company has now assumed charge and rents the power to the cars at $1.60 per day.]

In estimating the road expenses more than liberal allowance is made, but in a new enterprise it is safe to err on this side rather than attempt to claim for a system advantages which will not in practice be borne out. The expenses are then as follows:

Oil, grease and waste	$4.50	
Brushes	3.00	
Trolleys	2.00	
Material		$9.50
Three mechanics and one helper for thoroughly overhauling motors once a week, making repairs, adjusting brakes, etc	7.90	
Four inspectors, two day and two night, for oiling machines and looking after brushes	7.50	
Two night inspectors to thoroughly inspect motors after cars are laid up and see that all bolts, nuts and connections are tight and that everything is in good working order for the morning run	4.00	
One winder and helper for making any repairs which may be necessary, and any testing which is required	3.50	
Two linemen	5.00	
Labor		$27.90
Depreciation on car work at 15 per cent	18.00	
Depreciation on line work at 10 per cent	4.00	
Depreciation		22.00
Total road operating expenses		$59.40

or $1.98 per car, making 80 miles.

The total motive power expenses both in the central station and out on the road would not then exceed $3.46 per car making eighty miles, or 4.32 cents per car mile, and this includes everything except the executive and salary expenses, taxes and insurance, and is less than forty per cent. of the cost of operation by horses with the same number of cars, and under the same conditions.

But the showing is even better than this, for another fact is to be noticed, and it is an important one from an economical point of view. For example, twenty cars on duty for about eighteen hours make a mileage of from 1,500 to 1,800 per day, and if it were not for the fact that the schedule requires them to operate part of the time on a single track with insufficient turnouts they could make 1,800 to 1,900 steadily. This, notwithstanding the fact that the speed is limited by municipal regulations. Many of the cars often run 90 to 100 miles. The same mileage and intervals made by twenty electric cars could not, under the circumstances, be made by anything less than twenty-five horse-cars of the same size, and the electric cars probably carry in the aggregate just as many passengers. It follows that to get the same service with horses not only would the number of cars have to be increased, but likewise the number of horses, conductors and drivers. The same mileage performed by horses without these cars and grades would require a stable equipment of not less than 300 horses.

A good idea of the operation of the system may be obtained from the following weekly table, taken from the records of the railway company up to the present date:

Week ending.	No. of cars put out for regular service.	Av. No. of cars out per day.	Miles per week.	Avg. miles per day.	Av. miles per car per day.	Passengers per week.	Av. passengers per day.
Feb. 8..	72	10.3	2,632	376	36.5	18,764	2,680
15..	48	6.9	1,211	173	25.2	6,688	956
22..	77	1.0	2,604	372	33.6	16,504	2,358
29..	91	13.0	4,039	577	44.4	21,944	3,135
Mar. 7..	94	13.7	5,047	721	52.6	25,963	3,580
14..	86	12.3	5,313	759	61.8	20,897	2,985
21..	99	14.1	6,916	988	69.9	30,357	4,337
28	113	16.1	8,621	1,232	76.3	27,076	3,865
April 4..	118	16.9	8,351	1,193	70.8	28,360	4,037
11..	133	19.0	10,089	1,441	75.9	36,683	5,240
18..	133	19.0	10,683	1,526	79.6	40,090	5,727
25 .	135	19.3	10,895	1,557	80.7	39,040	5,577
May 2..	137	19.6	11,309	1,616	82.4	45,350	6,479
9..	140	20.0	10,832	1,548	77.4	51,643	7,378
16 .	176	24.1	11,563	1,652	65.8	58,598	8,371
23..	186	26.6	12,128	1,733	65.2	55,163	7,880
30..	194	27.7	12,789	1,830	66.1	57,519	8,217
June 5..	189	27.0	14,154	2,022	74.9	52,920	7,546
13..	187	26.7	14,649	2,093	78.4	59,219	8,459
20 .	181	25.9	14,371	2,053	79.2	70,965	10,138
Total ...	....	....	178,096	.....	....	762,648	.....

With the mileage which is now made, there is an actual saving of about $125 per day in the motive power expenses as against operation by horses. It is hardly necessary to point out that this would pay a good interest on a pretty large investment. The capacity of the road to economically carry passengers has been made so apparent that the old city railway, which was operated by mules and has about thirteen miles of track and fifty cars, has been bought up and is to be equipped with motors operated from the same central station. A third line will probably be added, and in the near future every street car, to the number of one hundred, in Richmond and Manchester, will be electrically operated from one station.

From this same station is operated a power and light circuit.

Having thus seen what is possible on a street railway, let us briefly consider the application of electricity on a larger scale.

The failure of the elevated railroads in this city to meet the issue of rapid transit is in no way more forcibly illustrated than by the number of plans which have been brought forward for discussion. No less than eleven have presented themselves, several of which have features in common and claim similar routes; and I will but very briefly review them.

The Beach Pneumatic was merged into the Broadway Underground, and this in turn into the New York Arcade Railway company, and is now familiarly known as the Arcade. They propose to run from the Battery, thence to Broadway and Madison Square, with four tracks, the two center being express tracks, with stations one mile apart, and the two outer tracks for way traffic. Thence the route extends to Fifty-ninth street by Broadway, and to the Harlem River by Madison avenue, with an additional route up the west side of Central Park by the Boulevard or some other avenue, and into the annexed districts. Branches are proposed to connect Broadway and Madison avenue on Twenty-third street, and the two branch roads on Forty-second street.

The Underground Railway Construction company has pooled the issues of the New York District, New York Underground and the Metropolitan Junction company. The route of the first is similar to that of the Arcade and runs from the Battery to Broadway and Madison Square with four tracks; thence up Broadway to Fifty-ninth street, and up Madison avenue over the Harlem River to some point near Jerome Park. Branches are also proposed from river to river on Twelfth and Twenty-third streets. The New York Underground road propose to run from the City Hall Park east to Broadway, through Centre and Mulberry streets to Lafayette place and Fourth avenue, at Union Square. Thence by two lines to the Grand Central, and Broadway and Fifty-ninth street, up the Boulevard to Kings Bridge, the main line continuing under Madison avenue to the Harlem River and by a loop to Kings Bridge.

The Metropolitan Junction company proposes to connect with the two last named in the annexed districts, and then run over the Hudson by a bridge at Washington Heights, connecting with a tunnel through the palisades.

The City Railway company proposes to begin at South and Whitehall streets, crossing Broadway below Rector, running between Church street and College Place, Sixth and Seventh avenues to Fifty-ninth street and the Boulevard. The line would then run up the west side of Central Park, crossing the Harlem River above High Bridge, terminating in New Rochelle. Branches are proposed for the principal ferries on both rivers, the Post Office and Grand Central Station. The roadway is intended to be 50 feet wide and 12 feet below the street surface; is to have four tracks, two way and two express. It differs from the other underground railways in that, instead of taking the street lines, it proposes to purchase the necessary property and erect buildings over the line of the road, which are to be rented for sufficient to pay the bonds of the company. The road thus running through the basements, so to speak, of the buildings, and crossing the streets by tunnels, becomes a covered roadway instead of an open one.

The Terminal Underground Railway company proposes a four-track underground railway from the City Hall along the proposed Elm street improvement to the Grand Central Depot.

The Metropolitan Transit company proposes two elevated street structures, one on Broadway, between Chambers street and Forty-third street, connecting with the Grand Central Depot, and the other on the West Side following the line of the water front to Gansevoort Market, thence up Tenth avenue and the Boulevard to Kingsbridge.

The plant proposed by Heman Clark is one of the most radical. He proposes a four-track tunnel, beginning near Fleetwood Park, cut in solid rock 150 feet below the surface, coming down about 100 feet west of the line of Broadway to the Astor House, where it would connect with

METHOD OF JUMPING FIRE HOSE ON TRACK.

[1] Read before the American Institute of Electrical Engineers, June 13, 1888.

two two-track branches, one going under the North River to Jersey City and Newark, and the other under the East River to Brooklyn and Prospect Park. Passenger stations would be at the foot of shafts sunk every two miles, and freight stations at intermediate shafts where freight pockets would be tunneled. Barge elevators would be used for handling the passengers and freight.

All of these schemes have their good and bad points which I do not propose to here discuss: but whichever is successful, they hope to use electric motors for propulsion. Now whatever we may claim for electrical motors, it would be folly to attempt the handling of the traffic of such a road without full knowledge as to the character of the work which has to be performed and a perfectly definite idea of the system of train dispatching which will best meet the wants of the public and, at the same time, preserve an effective and economical system of operation. To fully consider this let us briefly review the work which is being done on the elevated railroads, for example on the Third avenue line.

This is eight and a half miles long. Grades vary from eight to one hundred and five feet to the mile. The level stretches amount to about one-third of the whole distance, and this includes the stations. On the seventeen miles of single track there are fifty-two stations. In the busy hours there is no less than sixty-three four and five-car trains on the tracks. These trains weighing from eighty to ninety-five tons, make the half trip in forty-two minutes, including stopping at twenty-six stations and discharging and taking on passengers or at the rate of about ten traffic miles per hour. The works of the engines, which may be divided into three parts, overcoming the train's inertia, lifting the train on the grades and traction, and the maximum is at least seven times that necessary for traction at mean speed on a level. Three times in every mile this weight of 80 to 95 tons must be started from a dead rest, raised to a speed of twenty or more miles an hour, and brought to rest in about eighty seconds. The engines have to be run with 130 pounds boiler pressure, and have a capacity of 185 horse power. Fifty-nine per cent. of the power on a round trip is used in starting, 24 per cent in lifting, and 17 per cent. in traction, and the average power developed per minute per round trip, including stoppages, is 70.3 horse power.

The traction necessary to handle these trains is obtained by a locomotive weighing 22½ tons, of which only 15 are carried by drivers five feet apart. With an engine and the forward trucks of one car between two girders, we have a weight of nearly 1,500 pounds per running foot. The present weight of engines is not sufficient to properly handle these trains when the tracks are in a slippery condition, and it is not wise to increase it. It is absolutely necessary to keep up the high character of the engineering work of this road, and every consideration of business prudence and public safety will permit of no laxity in this direction. Yet these locomotives have done wonderful work. Although on duty for twenty hours, with steam admitted to the cylinder for six hours only, with an average horse power of only 38 per cent. of the maximum, and with all the incidental losses of steam, they develop a horse power with less than a total expenditure of 6.2 pounds of coal per hour; and the coal expense alone is only about $1.15 per round trip, or 2 1-5 cents per train station. The operating expenses are 62 cents per train mile; or, allowing an average of four cars per train, 15½ cents per car mile; and this includes everything.

The percentage of expenses of operation and maintenance for the whole Manhattan system may be roughly expressed as follows:

Motive power	42.8
Maintenance of cars	5.4
Movement of traffic	38.4
Maintenance of way	8.2
General expenses	7.2
Total	100.0

The coal alone costs over $700,000 per annum, which is more than the wages of the engineers and firemen, but it is only about one-sixth of the total operating expenses Hence there are other reasons than merely a saving in coal which must be urged in favor of an electric system as against a steam system.

Generally speaking, the real needs of rapid transit are not best subserved by the handling of long trains from a single tractive engine. True, the conditions of service on the elevated railroad, the crowded condition of the track, and the great cost of operating independent steam engines make it impracticable to work with small train units there. But the fact remains that the effective length of train which can be operated by any system is limited; that this limit has already been reached on the elevated railroad, where only one-sixth of the weight is now effective for traction; and that the smaller the units the less the momemtum of the train and the easier it is to quickly and efficiently handle it, and the less will be the liability of, and danger from, any derangement of the brake apparatus. Furthermore, the thrust of the moving weights on the grades, the vibration due to the shifting of the weight along the girders, the tensile, shearing and crushing strains on the structure are all materially increased by the use of a heavy locomotive at the head of a long train.

But since we must endeavor to meet all conditions of engineering, we must try to meet that one which requires the operation of a heavy train by a single motor car. In this case I deem it advisable to make the motor car of about the same size as the cars which form the train, equip both trucks and thus spread the weight used for tractive purposes over a larger distance. We have now partly constructed a 300 horse power motor equipment of this character.

This car, whose general external dimensions are similar to those of the regular elevated passenger coach, differs in its construction in many important details. The front and rear platforms are inclosed, and about ten feet at each end of the car—that is, the space over the trucks—is partitioned off and reserved for the use of the motor man. The middle space has side entrances, and is fitted for passenger accommodation. At each end of the car the floor framing is raised about twelve inches for a distance of about ten feet from the end, and the car body is carried on two very strong and heavy special iron trucks mounted on forty-two-inch wheels fitted with five-inch steel axles. Each axle has an independent movement and is driven by a tandem motor, centered upon the axle, which bears a part of the weight. The motor is also carried by heavy compression springs hung from the truck, by means of which as much of the weight of the motor as is desired can be thrown onto the boxes. Each motor, which is of about 75 horse power normal capacity, has two armatures, each of which is connected to a fixed and adjustable gear on the axle. the ratio of the gearing being about 1 to 3. These motors will have one brush on each commutator, and that will be a top brush. Each motor has directly over it, in the engineer's room, trapdoors fitted with heavy glass panels, which allow the machines to be seen at all times, and through which the machines can always be reached. The controlling devices and switches are all duplicates, and the car can be handled from either end. The car and the trucks are completed;

the motors are well under way. The car will be capable of exerting a tractive strain of at least 20,000 pounds—more than double that of the present locomotives.

But this is not the ideal method of traction.

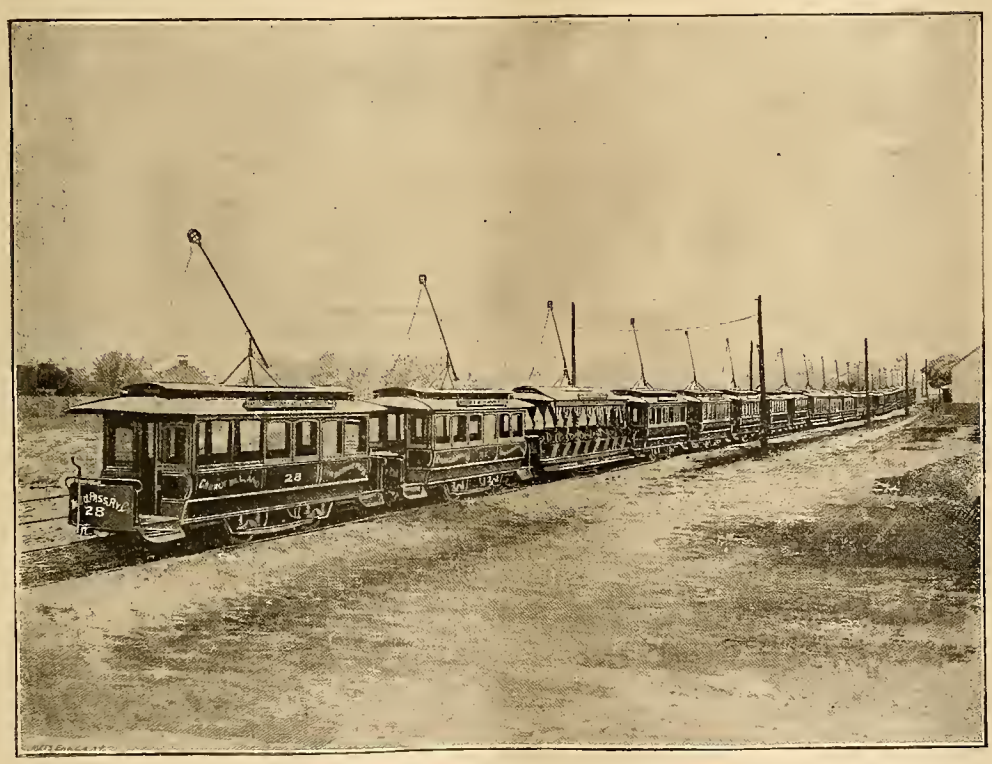
By a system of electrical propulsion, the power can be distributed underneath the cars, every car, or every two cars if need be, being a unit; and, although I do not think it advisable, arrangements could be made for propelling a large number of cars under simultaneous control. By distributing the power under the car, the whole weight of the car and passengers can be made effective for traction. This will enable the cars to be started more promptly, brought to speed more quickly, and stopped in shorter intervals, increasing the mean rate of speed for a given maximum, or vice versa, reducing the maximum for a given mean rate. By making cars individual units of locomotion, the intervals between trains may be made one-fourth or one-fifth of the schedule which must exist where four or five-car trains are used. It may be said that this will increase the number of the employes that are necessary. This is true, but it will increase the number of passengers who, both day and night, would make use of the system in such a ratio as would make this increase of expense insignificant.

Let us consider a possible system which would go a long ways toward solving the question of rapid transit. I will briefly point out its features. It would have four tracks extending from the Battery up Broadway to Twenty-third street; thence diverging in two divisions, each still with four tracks, one along the line of Madison avenue to the Harlem River and terminating near the Jerome Park district; the other following Broadway and running up the line of the Boulevard and Tenth or Eleventh avenues. Two tracks would be reserved for express traffic, with stations a mile apart, and two for way traffic, with stations every third of a mile, every third way station corresponding with an express station. The tracks would be arranged in two tiers, the express tracks being the lower. The entire system would be lighted, ventilated and operated by electricity, to be supplied from four stations on the water front, one at the Battery, one at East Twenty-third street, one at Madison avenue crossing of the Harlem River, and one on West One Hundred and Twenty-fifth street; the stations to be operated by compound condensing engines in three units connecting directly to large, slow moving multipolar dynamos, two engines being of sufficient capacity to handle the demand made upon any station; trains to be operated with one, or at most two car units; motors to be on the trucks of one car, centered on the axle and with one reduction of gearing; express speed to be thirty miles an hour, and way trains to make twelve traffic miles per hour; the current to be delivered to the cars by an overhead system with underneath contact, the contact wheel to be carried on the car, supported over the center of the truck and trending a little abaft it. Freight pockets at the level of the way track could be run under the cross streets at express stations. Track to follow a line of grade of not more than 25 per cent.; access to stations to be by stairways, and where there is any material difference between the street level and the track, by hydraulic elevators, operated from constant pressure tanks kept supplied automatically by electric motors. Freight trains to be run on way tracks.

Supplementing this system should be a line of surface cars, likewise operated by electricity from the same general source. In the heart of the city these can be operated from a conduit, or by the storage battery, and in all the suburban extensions by the overhead line system.

The objection of loss in transmission and recovery has

(*Continued on page* 57.)



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CONTENTS OF THIS NUMBER.

Mather Plant in Hotel Del Coronado. Illustrated..... 51
Chicago City Electric Light..... 51
Vestibuled Electric Cars..... 51
Heath's Self-Timing Speed Indicator. Illustrated..... 52
Chicago Electric Club..... 52
Motor for Horse Cleaning. Illustrated..... 52
Sperry Electric Company..... 52
The Auditorium Electric Plant. Communication from the United States Electric Lighting Company..... 52
Telephones in Sweden. Communication from Thomas D. Lockwood..... 52
Suggestions for the Board of Electrical Control. Communication from E. A. Sperry..... 52
Forsyth's Elevated Suspension Railway. Illustrated..... 53
Telegraphers' Trials..... 53
Cleveland Electric Road..... 53
The Solution of Municipal Rapid Transit. By Frank J. Sprague Illustrated. Part III; concluded..... 54, 55, 57
Editorial..... 56
Edison English Patent Decision..... 57
High Tension System before the Board of Electrical Control. Part II; concluded.
Communication from O. B. Schallenberger..... 57, 58
Communication from H. M. Byllesby..... 58
Communication from the Safety Electric Light & Power Company..... 58, 59
Communicatioh from Seymour G. Smith..... 59, 60
Affidavit of W. L. Wright..... 60

DEPARTMENTS.

Correspondence..... 60, 61, 62
The Electric Light..... 63
The Telephone..... 63
The Electric Motor..... 63
The Telegraph..... 63, 64
Electrical Patents..... 64

A VESTIBULED electric street car train will soon be run on the road between Council Bluffs and Omaha. It will be, it is said, the first in the world.

An interesting legal decision is noted in the correspondence from Los Angeles, Cal., in which the validity of an acknowledgment taken by telephone is affirmed. The court gives strong reasons for the position which it assumed.

THE letters received by the Board of Electrical Control of New York City from electricians in all parts of the country go to show that the latter have quite an intimate anatomical knowledge. They speak of the effect of the electric current on the human body with a readiness which evinces no little thought and study.

PROF. BARRETT, city electrician of Chicago, thoroughly believes in the operation of an electric plant by the city. He says the economy of such a course is manifest. The new Chicago plant will soon begin operations, and it is to be hoped that it will meet with such success that the aldermen will see fit to extend the system.

MR. SPRAGUE'S exhaustive paper on the solution of the municipal rapid transit problem is concluded in this issue. The paper is an interesting one, and it has attracted widespread attention. Mr. Sprague's detailed statements ought to convince the most skeptical railway manager of the practicability and availability of electric motors for street car purposes.

JAY GOULD'S illness has given rise to numberless rumors concerning the Western Union Telegraph company. The report which has gained the greatest circulation is that which alleges he is about to dispose of his interest in the company to the Vanderbilts. The reporters have worked industriously, but thus far they have been unable to find any one who has not emphatically denied the rumor.

IT may be some consolation to telegraph operators in this country to know that their brethren in Venice are paid less than $4 per week. From this amount an income tax is deducted. All the comfort they can find in the situation is derived from the knowledge that their lot is more tolerable than that of the majority of those who are obliged to work for a living in that beautiful city.

THE semi-annual meeting of the National Electric Light Association will be held at the Hotel Brunswick in New York city, August 29th, 30th and 31st. In all probability the attendance will be larger than ever, and it is understood that the papers will be of great interest. The transportation committee is said to have secured reduced rates for those who will attend the convention from the west.

IT is to the credit of the English electricians that they do not attempt to deny the superior energy and enterprise of Americans. W. M. Mordey is quoted as saying recently: "As soon as the Americans get hold of anything that will work, they apply it. All the improvements in dynamos and in motors have practically been rejected on this side of the Atlantic. We seem to make the improvements for the Americans to make use of."

WHEN a mysterious fire breaks out in a building which is lighted by electricity the tendency seems to be to make the wires responsible for the blaze. This was the case after fire had destroyed Whitelaw Reid's splendid mansion at Ophir Farm, near White Plains, N. Y. An investigation demonstrated that the wires had nothing to do with the origin of the conflagration. The house will be rebuilt, and all the electric features will be duplicated.

THE question has been asked how much money the ocean cable companies have made while the twelve-cent rate has been in existence. It is said that the Commercial company made $200,000. On an investment of $10,000,000 this amount is not a brilliant percentage, to say the least. If the cable had been broken this $200,000 would have disappeared. The other companies, it is stated, were not quite so fortunate, and have made nothing at all. The new 25-cent rate will go into effect probably on August 15th.

IN a recent speech before the selectmen of Brookline, Mass., Henry M. Whitney, president of the West End Street Railway company, in asking for permission to erect poles for the operation of the road by electricity, made the following sensible and timely remark: "I believe that the electric motor at this day has reached that stage of development which makes it a perfectly practicable working machine, superior in all respects to horses for quick transportation." This view of the case is one which street railroad directors can afford to ponder over.

BUFFALO has several sensible aldermen as will be noted by reference to the correspondence from that city. One of the city councilors in urging the proposition to light the city by electricity, said that the introduction of electric lights had already saved the city millions of dollars by causing the gas companies to lower the price for their illuminant. "The city must expect to pay more for electric lights than for gas," said another level headed alderman. "If not then the city ought to use tallow candles, which are cheaper than anything else."

THE last of the series of letters and documents presented to the New York Board of Electical Control is concluded in this week's issue. Whatever may be said of the question at issue, no one will deny that the advocates of the alternating system presented their side of the case with ability, vigor and clearness. The letters are almost without exception well written, and they will form important additions to the literature of that interesting topic, "The Alternating vs. Continuous Current." We adhere to the position which we assumed toward the question last week. Prohibition of any system is not needed in New York, but rather control of all by the proper authorities.

THE north side cable road of Chicago does not improve with age. It has become demoralized several times during the last week, and on one or two occasions hundreds of north siders were obliged to walk home in a pouring rain. The knowledge of these facts does not tend to increase the demand for the cable among the residents of the west side of the river. Another experiment with the cable is be made, however, and in a few months the residents of the west section of the city will be obliged to endure the discomforts which now afflict those who live on the north side. The railway company has been repeatedly urged by the press and the people to look into the merits of the electric system for the west side, but for some reason not easily imagined no attention has been paid to these requests. In view of the marked success of electric roads, it is unfortunate to say the least, that a system better than the cable cannot be tried on the west side. The Chicago *Daily News*, which has advocated the use of electricity, thus speaks of the extension of the cable system: "Yerkes is now about to introduce his 'rapid transit' system on the west side of the town. He has set things back about ten years on the north side, and we are curious to see whether the west siders will submit to his rule-and-ruin policy. The dismal failure of the north side cable line has demonstrated pretty clearly, we think, that as a means of rapid transit surface roads are wholly incompetent. Four miles an hour is not rapid transit. Philadelphia may think so, but Chicago doesn't."

GEORGE KENNAN, whose series of articles on Siberia is attracting such attention, first gained his knowledge of Russia and Siberia when visiting those countries to promote the construction of the overland telegraph. He spent two years in Russia and Siberia before the gigantic scheme was abandoned on account of the success of the Atlantic cable. Mr. Kennan is now one of the managers of the Associated Press at Washington. Of Mr. Kennan the Chicago *Standard* says: "He early learned the Morse alphabet system, and it is said that before he was six years of age he had sent a telegraphic message. This will not appear so strange when it is stated that his father was the manager of the Western Union telegraph office. His father was a college graduate and the boy's studies were pursued under his supervision, while his knowledge of telegraphy was also acquired from him. The demands of the war for and upon telegraphers, one of which important auxiliaries to modern warfare he early became, prevented young Kennan from entering college, for which he had made preparation. So arduous were his efforts in the line of his profession that sometimes he was at his key from six o'clock at night until eight in the morning, stopping only for momentary respite. At the age of eighteen, the year before the close of the war, the plan of the Western Union company to run this telegraph line across Asia, was a topic for newspaper talk. Kennan, who had worked himself down to poor health, was ready to accompany such a party of telegraphic pioneers who would undertake this task, and offered his services to Gen. Anson Stager, then president of the company. Two days after his letter to the company, the inquiry came, "Can you get ready to start to Siberia in two weeks?" To which he characteristically clicked this reply over the wire: "I can get ready in two hours." Overcoming the prejudices of his parents, and recovering from a serious sickness, the young man started on his long journey and spent three years on the other continent before returning to his native land. So congenial to his taste did this strange out-of-door life become to him that he has revisited the land of the Tsar four times since, and traveled by rail and sledge and Russian carriage thousands of miles."

(*Continued from page* 55.)

been raised as against an electric system, and also the question of braking. These are easily met.

We have systems of electrical braking a train by the use of its motors; which consists in converting them into dynamos, deriving their driving power from the train, and using up its energy by converting it into electrical energy, which can be used in a variety of ways. In a storage battery system the energy of the car can be made to partially recharge the batteries on a down grade, and in stopping. In a direct supply multiplearc system, operating a large number of cars, this power of being able at will to convert the energy of a moving train into electrical energy delivered to the line by the same apparatus which controls the speed and power of the train, is of exceptionable importance. In a double track system, the energy given to one track may be communicated to the other just as efficiently as along itself. In fact, in the entire electrical system every part is mutually connected, and there is a bond of union between the different trains far more perfect and effective than any mechanical connection could be. The upgrades on one track being equal to the down grades of the other, it is evident that the total upgrade of a system is equalized by the downgrade thereof. If, then, energy is expended in getting under way and climbing upgrades, and a large proportion of this can be recovered in stopping and in running downgrade, it is evident that the total initial energy required would be that necessary to remove the trains continuously on level grades, with a percentage for loss in conversion and reconversion added. The more train units which are operated, and the more frequent the stoppages, the more marked is this advantage in an electric system.

I some time since made a number of determinations of a system of the equipment capacity of the Third Avenue Elevated, in which I found that about 40 per cent. of the power could be saved by this system of braking, where every motor coming to a station or running of a downgrade is made a generator which is helping to supply the current needed to operate the remaining trains.

Instead of the current being all supplied by a main generating station at one or two points, it would be supplied from nearly as many moving stations along the line as there would be trains slowing down or running on a downgrade. In fact, the loss of the two conversions and one transmission would be more than counter-balanced, and consequently the original horse power at the central station would be no more than the aggregate net horse power now developed on the entire line, and this is only about 38 per cent. of the total capacity of the engines. With any given potential and losses on the line, the main conductor would be very much smaller. Not only on the line, but at the central station would a saving be effected; for in a system of the capacity of that which we are considering this saving on lots, building, boilers, engines, dynamos and fittings would be not less than $400,000, and there would be about 40 per cent. saving in the coal, labor, depreciation and incidental expenses of the central station.

Another method of using the motors for breaking purposes is to break the connection from the line, and reverse the machine through a local circuit on the train, varying either the local circuit or the circuits of the machine. While in this position of breaking, if the local circuit is opened and the line connection made, the machine would be instantly reversed.

Elaborate experiments were made by me nearly two years ago on the Thirty-fourth street branch of the New York Elevated railroad, in which these questions of gearing, of mounting the motors on trucks under the car and handling the car without shoebrakes, were very thoroughly studied. There this method of braking was shown to be under the most perfect control. When desired, the braking could be made so sudden as to cause the wheels to have a continuous skidding rotation, not such a skidding as is caused when an air brake is put on too sharply, but a rotating slip which is just enough to relieve the armature when the strain on it reaches the point determined by the coefficient of adhesion on the rails.

This is the ideal method of braking, because fixed skidding and flat wheels are an impossibility, and the wheels will turn until the train comes to a dead stop, although, where the braking power is put on too suddenly and exceeds the grip of the wheels, they will relieve themselves by slipping just enough to keep the braking at the maximum limit. A train so governed can be made to creep down the maximum grade of a road at a snail's pace, and in an emergency such a car, running twenty-one miles an hour on a down grade, has been stopped and reversed within ninety feet.

When the electric motor is reversed its action is cumulative, for so long as its motion continues in its normal direction, it tends to augment the current which flows through it with any given setting of the switch, and thus very much increases the effort to stop itself; and the higher the velocity at which the armature is traveling, the greater this effort. In fact, it would be practically impossible with a properly constructed railroad motor to prevent its reversing when the switch is thrown over far enough. This is another point in which an electric motor has a great advantage over a steam engine.

So it would seem that electricity has practical advantages over steam for this character of traffic, and there are considerations other than purely engineering ones. The use of electricity instead of steam would do much towards making a road of this character popular. We would have express and way trains, starting and stopping smoothly and quickly, moving at a high rate of speed and running at short intervals. Dust, smoke, cinders, oil and drippings would disappear; the air would be purer and cleaner. The trains would be safer and under more perfect control; motive power would cost less; depreciation on the track structure would be much less; the carrying capacity would be increased; cars would be brilliantly lighted; comfortably heated; in short, everything which would make rapid transit safe, pleasant and effective is possible by a properly developed system of electric traction.

One of the most important sources of revenue from such a system would be the sale of power for stationary purposes. Already we are operating no less than 130 different industries by electric motors, and the receipts vary from $60 to $150 per horse power. The extent of the application of electricity with any such general source of supply can hardly be conceived. Its profits would be far more than enough to pay the total cost of motive power.

But we must not shut our eyes to the work which has got to be done. We must not exaggerate the advantages of electricity; we must not belittle the position of a system which has been developed by the ablest engineers for the last forty years. All their experience, all their study, all their victories form a magnificent groundwork for us to build upon, and will render the final victory of electricity more easy and certain if we build wisely and take to heart all the lessons which their years of experience teach us. In a small fraction of the forty years which have marked the development of steam engineering, electric engines will rival in mechanical perfection, in construction and performance, the best locomotives. Even to-day, weight for weight, and duty for duty, the electric motor is already rivaling and outstripping its predecessor. For the present and for a long time to come it is probable that for trunk line work, and for the original source of our power in an electrical system, we will be dependent upon the steam engine, but we all hope and expect that the future will bring us some other effective means of converting the energy of coal into electrical energy, and that by some direct method which will not require the intervention of a steam engine and dynamo. It is not too much to hope for, and already experiments have been made which foreshadow this great result. The success of this discovery would produce such a revolution in the use and distribution of power as to exceed our most sanguine expectation.

Edison English Patent Decisions.

Two opinions exist in England in reference to the decision in the case of Edison and Swan against Holland. Justice Kay found that the Edison incandescent lamp patent was invalid, and that the Cheesbrough patent which covered the flashing process had been infringed by the defendant. The two opinions relate to the probable outcome of an appeal. On the one hand *Industries* says: "Of course the Edison-Swan company may appeal as to the Edison patent, and the defendants may appeal as to the Cheesbrough. We think, however, that nothing would be gained on either side, as the Edison patent seems hopelessly invalid, and the Cheesbrough patent has had three judgments in its favor."

The *Electrical Engineer* rather holds to a contrary view. It comments particularly on this reason of Justice Kay for invalidating the Edison patent: "Secondly, because his specification does not describe a lamp, which ever became, or, as I think, could have became commercially successful." The paper adds: "Whether Justice Kay's judgment will be upheld because of the other reasons given is a matter upon which we offer no opinion, but to make the validity of a patent depend upon whether or no the article has succeeded commercially, as manufactured according to the specification, is a matter that cannot by any possible means be allowed to be recognized till it has been upheld by a higher jurisdiction."

The Review says: "The Edison lamp monopoly now seems to be completely destroyed. The judgment is so strong, and the conclusion depends so little on legal opinions and so much on facts, that we think there is no doubt that the judgment will be supported. The case will probably go to appeal, and perhaps to the Lords, for the policy of the Edison-Swan company will probably be to intimidate the industry as much as possible by advertising that they have several judgments in their favor, and only one against them, and that people will use other lamps on peril, as the validity will be sustained on appeal, and proceedings will then be taken."

The London *Electrician* says: Now that the prolonged and exhaustive investigation into the merits of Edison as an inventor of the incandescent lamp has at last come to an end, and judgment has been pronounced invalidating the patent, the strongest impression left upon our minds is one of utter astonishment that a stringent monopoly should have been maintained so long and so successfully upon a patent of so flimsy a character. "Flimsy," we think, is not too strong—or rather too weak—a word to describe a patent which has been declared invalid on points so fundamental and so numerous as the following: Because it does not describe a lamp which ever became commercially successful; because the directions were so insufficient that no one could make the carbons described without previous experiment; because one of the processes set forth is positively injurious, and the clauses relating to coated and coiled filaments are of no practical utility; and lastly, because the claim for a monopoly of incandescent lamps having a filament of carbon is far too wide, "considering," as his lordship added, "how little Edison has actually invented." We believe that no unprejudiced person who has followed the proceedings can fail to admit that the weight of the evidence demanded this decision, and we must now recognize the fact that the claims of Edison to be regarded as a discoverer of any element of the first importance in incandescent lamp manufacture are thereby finally exploded.

Once more, says an English paper, suggestions are in the air for a postal tube between Dover and Calais, and this time in a more detailed form. The idea is to suspend two tubes of about a yard each in diameter by means of steel cables across the Channel, forty yards above the level of the sea. The steel cables will be fixed to pillars at distances of about 800 yards, and in each tube a little railway will run, with cars capable of carrying 450 pounds in weight. No parcel of greater weight than this will be taken, and the cost is estimated at the modest figure of £1,000,000. It is also proposed to run telegraph and telephone wires through these tubes.

High Tension System Before the Board of Electrical Control.

PART II.

COMMUNICATION FROM O. B. SHALLENBERGER.

C. J. Jackson, President Safety Electric Light & Power Co., New York:

PITTSBURGH, PA., July 7.—In reference to the questions which you have brought up for my consideration regarding the safety and reliability of the alternating current system of distribution, I would say first, in regard to the matter of personal safety, that I regard the alternating current less dangerous to human life than the direct current, for several reasons. In the first place I am well acquainted with a number of electricians and men connected with electric lighting work who have received through their bodies a current due to alternating difference of potential, varying between 1,000 and 2,000 volts. I have myself received 1,000 volts without even temporary inconvenience, and in the case of one of the electricians connected with our interests, a shock of something greater than 2,000 volts was received without fatal results. During my experience with direct current dynamos, I have frequently received a shock due to the extra current from the field of a machine suddenly opened, and I have no hesitation in saying that the shocks I have received in this way from machines designed to produce only 100 volts electromotive force, were much more severe than those I have received by direct contact with the primary circuit of a Westinghouse 1,000-volt dynamo, when its field was charged to the full normal amount.

It is simply out of the question to produce any practicable extra current in the armature circuit of an alternating current machine from the opening of the field, particularly when the machines are separately excited, and this is for the reason that there is no connection between the armature and the field circuits and the effect of suddenly interrupting the field current is only to interrupt the current in the armature without producing a sudden flash of high electromotive force which inevitably follows from the interruption of the field of a direct current machine. The construction of the alternating current dynamo is such that, although the current changes its direction 200 or 300 times a second, yet it is prevented by the very nature of the machine from raising any potential beyond a certain limit determined by the design of the machine. In the direct current machine on the contrary there are no such restrictions, and I feel quite safe in saying that the discharge from the field of a direct current machine of 100 volts normal potential may be capable of rising to fully 1,000 volts when the field curcuit is suddenly interrupted. I do not give this as a matter of opinion solely, but as a matter of actual experience and conviction. This quality of the direct current machine has often rendered it neccesary in my own experience to interpose a number of incandescent lamps, say five or six, across the breaking points of the field rheostat, so that on the interruption of the field circuit the arc formed across those contacts would be prevented to some extent; the result of this arrangement is that half a dozen or more lamps connected in series would be flashed up to their full brilliancy by the so-called 100-volt dynamo; whereas, under normal conditions, it would require as many 100 volts as there are lamps to produce a similar condition. There is a very convincing reason for the small danger due to alternating current shocks to the human body as compared to those received from the direct current; namely, the fact that the conducting fluids are more or less decomposed or electrolized by the passage of the direct current, while it is well understood that such an effect is not produced by the alternating current. It is therefore evident that the passage of the direct current through the human body, for even a moderate length of time, may be sufficient to so decompose the fluids and tissues of the vital parts as to produce fatal results very quickly; whereas, a current of the same quantity of rapidly alternating potential may produce only a shock to the nerves without any organic change, consequently without permanent or even serious danger. This statement is well borne out by the fact that it is impossible to measure correctly the resistance of the human body by means of a direct current as the resistance changes continually while the measurement is in progress, even where the contacts are preserved carefully and where the utmost care is exercised to produce accurate results. The decomposition of the fluids thoroughly explains this, since it is a well-known fact that in all cases of electrolytic action the resistance is never the same for any considerable period. With the alternating current system it is possible to obtain definitely the resistance of the human body with contacts of a given nature; consequently the effects of the alternating current can be determined and counted upon much more easily than the direct.

Laying aside the question of the relative danger of the alternating and direct current, it is a matter of everyday experience that a 50 or 100 alternating current is perfectly safe and it is perfectly possible and easy to confine the difference of potential entering a house from the street circuit.

The insulation on the converters as now employed and as they have been in use since the commercial operation of the alternating current system, is so perfect that among several thousand converters now in use, under the patents of the Westinghouse company, I have yet to learn of a single instance in which any connection has been discovered between the primary and secondary wires. These converters have been in use under almost every conceivable condition of location, and surrounding conditions and a large number of them being in use in the open air, and up to the present time no accident to life or property has been recorded. As a matter of fact, the converter is a safeguard to the consumer, protecting him from all dangerous currents likely to traverse his wires; namely, that from lightning. Where the circuit is continuous from the pole line to the lamps an excellent conductor is provided for the discharge of the lightning flash wherever the ground insulation happens to be the weakest, and for this reason we hear of lightning entering buildings and destroying property to a greater or less extent, particularly at the central stations where the greatest

number of conducting wires enter and where masses of metal are either more or less connected are apt to form the weakest points in the system of insulation. Where the converter is interposed between the line wires and circuit likely to be handled by the consumer, a safeguard is provided, the effect of which on the passage of a lightning discharge is simply to work an injury on the converter itself separating it from the surface wires, and temporarily interrupting the supply of current. In the experience of our company a number of cases have occurred in which lightning has almost totally destroyed the converters and the result has been in every case to disable the primary coil, cutting it out of action and immediately freeing this circuit from the converter, owing to the increased current passing through the primary coil under these conditions It will be impossible for the converter to remain in circuit when sufficiently injured by lightning to render insulation between the primary and secondary circuits insecure. Under all other conditions than the burning out of the converter by lightning or destruction by fire, the nature of the insulation between the primary and secondary circuit is so perfect that it is almost impossible that any connection should occur between them, since the insulation is made up of several distinct and perfect envelopes for the wire. These insulations are as water-proof as it is possible to produce them, when uninjured by a mechanical abrasion, and from the latter the coils are thoroughly protected by an inclosure in the iron casting with which each converter is provided. The insulations are not only carefully carried out from the primary to the secondary coil, but between each coil and the iron plates which form the surrounding field as that the insulation measured from one coil to the other through the iron is in reality double the insulation from coil to coil.

In regard to the question that has been raised as to the reliability of the safety fuses, I would simply call attention to the well-known fact that the fuses of moderate size are much more quick and reliable in their action than the large fuses. The current in our system traverses four pairs of fuses between the dynamo and the lamp, all of which fuses are of moderate size, even where 2,000 or 3,000 lights are distributed over the same primary circuit. In case of accident by lightning or otherwise, which would disable the converter, the usual effect is to immediately burn out the primary safety fuses of the converter, but, should this fail for any reason, the passage of an abnormal current through the secondary fuses would cut them out and, failing in this, they would have still between the converters and the lamps the local fuses which are of still smaller capacity, and therefore readily discharged. I might amplify on these matters to a very considerable extent, but have confined myself to explaining the material matters in which our system has safeguards which make it absolutely reliable to life and property. In conclusion, I might state emphatically that the converter, whether for underground or overhead use, and particularly in the latter event, is an element of safety of a very appreciable amount against danger from currents of higher tension than is used in alternating, which may, by any event, be brought into contact with the primary wires of this system. Yours respectfully,

O. B. Shallenberger.

Communication from H. M. Byllesley.

Mr. C. H. Jackson, President Safety Light, Heat and Power Company, New York, N. Y.:

Pittsburg, Pa., July 14.—I am in receipt of your favor inclosing a clipping from the New York *Evening Post*, which clipping simply is an attack upon the alternating current system signed by Harold P. Brown.

I have carefully read this article and beg to call your attention to the following facts and observations in connection with the same:

About twenty months ago the Westinghouse Electric company began the commercial introduction on a large scale of the alternating system of of electric lighting. The advantages of this system immediately appealed to the wants and experience of parties already engaged in central station lighting, and of those who up to that time had been seriously considering to go into the business, but had not actually embarked in the enterprise in consequence of the absence of any system which would fill all the requirements in a commercially successful manner. The first plant introduced by this company on the alternating system in this country was started at Buffalo, N. Y., on Nov. 30, 1886. After that other plants were rapidly sold and put in operation until, at the date of this letter, the Westinghouse Electric company and its licensee, the Thomson-Houston Electric company, have sold in Canada and the United States a total of 127 stations using the alternating system, and of which 98 stations are in operation at the present time, the remainder being under construction. Among these 127 stations there are several which, to the best of my knowledge and belief, are the largest incandescent lighting stations in the world. Notably, the Virgin Alley station in Pittsburg, which has a generating capacity of 15,500 16-candle power lamps, and which, together with its sub-stations, operated by the same company (The Allegheny County Light company), in Allegheny City and East End Pittsburg, make a total of 25,800 16-candle power lamps on the alternating current system, in daily use in the city of Pittsburg and Allegheny; being the largest number of incandescent lights served at the present time from central stations than any city in the United States. The plant of the Denver Light, Heat & Power company, Denver, Col., which was put in operation in December, 1887, is now supplying over eight thousand 16-candle power lamps. The central station at Richmond, Va., which originally started with 650 candle power lamps and subsequently increased to 2,600 16-candle power lamps, has now received another increase, giving it a total generating capacity of 7,600 16-candle power lamps on the alternating system. The station at New Orleans originally operated by the Southwestern Brush Electric Light & Power company, but now the property of the Consolidated Electric Light company, has over 7,500 16-candle power lamps in successful operation. At Baltimore, Md., the Brush Electric Light company of Baltimore City has just started a station of 5000 lights. The Richmond Light, Heat & Power company of Staten Island, N. Y., has a station which at present is operating over 4,000 16-candle power lamps.

Of the stations which are in operation at the present writing, and all of which have been sold and installed since Nov. 30, 1886, thirty-four have increased their plants since putting them in operation.

You will readily understand, upon a consideration of the foregoing, the enormous amount of work which has devolved upon the officials, electricians, and engineers of the Westinghouse Electric company, in developing and introducing this enormous business within so short a time, and that it has been considered inexpedient, heretofore, to take any notice of, or make any reply to, the criticism and attacks of some of the opposition electric lighting companies, which have developed recently in a method of attack which has been more unmanly, discreditable and untruthful than any competition which has ever come to my knowledge. The article of Harold P. Brown, referred to, is a fair sample of the class of attack. I have neither the time, nor the inclination to answer in detail the charges brought forward by Mr. Brown, nor indeed do I consider it at all necessary, as in spite of this and similar attacks above mentioned, the business of the company is steadily increasing, and the only result produced by such articles is a certain amount of annoyance.

However, I would say briefly, and all of which we are prepared to have substantiated by an intelligent and thorough test and examination of our system by any competent engineer or engineers:

In the first place, an alternating current is far less dangerous as to fire or life risks than a current of what is known as the continuous or direct current type. This is a matter which can be readily proved by breaking two currents, one of the alternating, and the other the direct, by the same switch. In the case of the direct current, a long and vicious spark will occur, which, if the current is of sufficient volume, will probably melt the edges of the switch. With the alternating current a spark barely perceptible, and with none of the heating and melting effects, will be observed by the same operation.

As to life risks, it has been demonstrated to our entire satisfaction, and the entire satisfaction of people who have given the subject an intelligent investigation, that the effects of currents of the two systems upon animal life, are very unequal, and the effect of the alternating current is immensely less, both as to burning and possible death, than the direct current of the same volume and pressure, as explained by Mr. Shallenberger.

Of the 98 central stations of the Westinghouse Electric company, now in operation, and all using the alternating system, we have yet to receive knowledge of a single case of fire of any description, from the use of our system. Of the 125 central stations of the leading direct current company, there are numerous cases of fire, in three of which cases the central station building itself was entirely destroyed, the most recent being the destruction of the Boston station, while among the almost innumerable fires caused by this system, among the users, may be mentioned the total destruction of a large theater at Philadelphia, which fire was directly caused by the direct current system of the leading direct current electric light company of the country.

Regarding the alleged life risks by the use of the alternating current system, I would say that the potential, or pressure, or electromotive force used on the primary lines with the system of this company is one thousand volts, as against a pressure on the three-wire, direct current system of two hundred volts. Greater care in running these primary wires, either overhead or underground, is required than would be the case if a lower pressure were used, and, it is possible, under certain contingencies, for a person through carelessness to become so connected with these primary wires as to receive a shock which may possibly prove fatal; but this risk is reduced to a minimum It is a common matter for the three-wire central station companies using the direct current system to run a special wire usually for street lighting purposes, carrying a potential on the direct current system of 1,000 volts, and which, as explained above, is certainly more dangerous in every way than 1,000 volts of the alternating system. It must be distinctly borne in mind, however, that the street wires carrying the primary current of the alternating system are never carried into the houses, and that the current which goes into the buildings and houses to feed the incandescent lamps has an e. m. f. of 50 or 100 volts, as against an e. m. f. of 200 on the three-wire system. And I further state, beyond any possibility of contradiction, that it is utterly impossible, by the construction of our apparatus, for a high tension current used in the primary wires to pass the converters and enter the houses. An intelligent examination of the construction of our apparatus will prove this beyond any question of doubt.

As to the alleged impossibility of the operation of our system on an underground circuit, I have only to say that any statement of this nature is absolutely and entirely false. The company using our system in Denver, Col., and which has been referred to previously in this letter, has been employing our underground system very successfully with a distributing capacity of over 12,000 16-candle power lamps. At Springfield, Mass., we have an underground system in successful operation with a distributing capacity of 2,100 16-candle power lamps. At the Keystone Light & Power company, in Philadelphia, they are distributing over 2,600 16-candle power lights through an underground system.

We are prepared at any time to furnish plans or take contracts for the introduction of our system by underground wires and to guarantee its successful performance under all circumstances, so long as our plans and specifications are adhered to, and the very successful operation of the three underground stations mentioned, certainly is more assuring in this direction than the very unsatisfactory performance of the underground three-wire systems, which underground systems have been attended with continual trouble, and have required the most careful nursing from the time they were started up to the present moment, as, for instance, at Detroit, Mich., Columbus, O., Chicago, Ill., Philadelphia, Pa., not to mention others. Whenever local companies are willing to incur the extra investment required for putting the wires underground, we are also prepared to furnish them the system with sufficient guarantees for its successful performance.

The dismal commercial results so far achieved by the majority of central stations using the three-wire system, owing to the fact that the low tension which they are required to use with that system prevents the possibility of their covering a sufficient territory to insure a permanently successful business, certainly warrants the expenditure by local companies of a little more cost in installation and care in construction of their lines to enable them to use such a system as the Westinghouse Electric company has so successfuly introduced, and by the use of which system any local company can permanently occupy the field instead of being in a position where it is continually harassed, and having its business cut into by other companies coming into the same field, while it is itself unable to strike out and occupy new territory.

The idea of locating a central station in the heart of the most thickly populated section of a city or town, as for instance, the three-wire system in Philadelphia, paying enormous sums for the haulage of coal and ashes, and even for the use of water for the boilers, when by the use of the alternating system of the Westinghouse Electric company, the same stations could be located on some river bank, or contiguous to a railroad, thus avoiding all expense of haulage and for water, is surely one which does not appeal to the common sense and experience of the people who are acquainted with engineering enterprises.

In closing, I would call your attention particularly to what is probably the most recent attack against this company, and a consideration of which, together with the accompanying facts as put forth in printed circular inclosed, will, I think, make clear to you the utterly irresponsible nature of the parties carying on such a campaign against us. I refer to the inclosed circular which has come into our hands marked "Confidential to Agents," and printed over the signature of Ed. H. Johnson, president of the Edison Electric Light company. This company, as you are aware, is using what is known as the three-wire low tension system. It is certainly manifest from this that the desperation of the opposition companies has reached a point where even a regard to their own interests is thrown aside, and the only explanation which I can apply to the issuance of the confidential circular in question is, to consider it as a last effort on their part.

The previous circulars and pamphlets that have been issued have been all of the same nature and are all susceptible of exactly as sweeping a reply as this, but, as explained previously, we have felt no injury resulting from the circulation of such literature, and have neither the time nor inclination to reply to it.

Trusting that this rather lengthy letter has at least in a measure replied to your inquiries, and again stating that we are ready at all times to invite the intelligent examination of our system by parties who will do so in a fair-minded and straightforward way, and in such a manner as was done by the Society of Gaslighting of which Eugene Vanderpoel, president of the Newark Gas Light company, Newark, N. J., is chairman. I remain,

Yours very truly, H. M. Byllesby,
Vice-President and General Manager.

Communication from the Safety Electric Light and Power Company.

Messrs. Commissioners of the Board of Electrical Control of New York City:

New York, July 7.—We tender our cordial thanks for the invitation extended us under the resolution adopted at your meeting June 8, 1888, concerning rules suggested in a communication published in the *Evening Post*, June 5, 1888.

As we will use the Westinghouse alternating current system, our reply to your invitation will be confined to the proposed rule, reading, "No alternating current with a higher electromotive force than three hundred volts shall be used," and to the preceding paragraphs which animadvert on the alternating current.

The Westinghouse alternating current system for incandescent lighting is in successful daily use in some eighty-two central stations, located in many states. Some forty-five additional central stations are being built to use the system, and this number is being increased at the rate of about two per week. Those in use have lighting capacities varying from 2,000 lights to more than 18,000 lights each, and all are being constantly enlarged to provide for the continued increased demands.

For the distribution of the alternating current generated in these central stations thousands of miles, both of overhead and underground conductors are used.

These numerous stations have been installed under the supervision of and are managed by as many local superintendents, most of whom had been previously entirely unacquainted with the Westinghouse alternating current system.

In the construction of these many stations with their numerous lights and miles of wire and cables, and in their daily operations in such extensive proportions, a very large number of employes have been and are now engaged who necessarily had no previous experience with the Westinghouse alternating current system.

Daily and hourly from these many stations the alternating current has been and is transmitted through miles upon miles of wires and cables to hundreds of thousands of lamps, providing light to millions of people, and yet, up to this moment, the first death, due to this, as the publication in the *Evening Post* designates it, "damnable and fatal" current, has to be recorded. Nor has there occurred a single instance of fire having been caused by the current from any of these stations, and the electro motive force in all the main or feeding conductors, from all these stations

to the converters, in every instance, is at least 1,000 volts.

Among the numerous employes of these stations, are living very many who have received direct from the generating machines, at the bare wires of the switchboards, the full intensity of this current. They received severe shocks, it is true, and the experience was not pleasant, but they were not killed. In most cases they continued at their work without interruption of more than an hour; they were not even made sick or nauseated.

Facts like these show as much as anything can possibly demonstrate that there is not "constant danger of sudden death" in the use of this current, to which it is stated in the communication in the *Evening Post*, "that the public must submit in order that corporations may pay a little larger dividends."

The utterer of such wanton statements, if not employed by some company to issue such a villainous budget of perversions of fact, must be desirous of achieving a cheap reputation with the general public, who imbibe the notion from the numerous misstatements of ignorant or dishonest persons that there is inherent danger in any use of electricity.

We submit herewith a letter from T. Carpenter Smith, who has been the superintendent of a station with 15,000 lights operated upon this system. He has had many years' experience with electricity in all its forms and knows the Westinghouse alternating current system by constant practice of several years. He has embraced in his own person this "damnable and fatal" current of 1,000 volts and that more than once. He has seen, as he narrates, several men receiving this current without any more inconvenience than burning of the hands, and perhaps the absence of a half-hour from their work.

We also submit copy of letter from W. H. Cole, superintendent of an electric light company at Richmond, Va., using this same alternating current. His experience has likewise been with many and various kinds of electricity for a number of years past. He, like Mr. Smith, has received in his own person this "damnable and fatal" current several times, and he has several men in his employ who have received it also.

We also submit copies of letters from the general manager and electrician of the Westinghouse Electric company, which make valuable contributions to the subject and merit the utmost consideration,

Our station at Twenty-fourth street and Thirteenth avenue will be erected in the best possible manner known to modern science, provided with all the appliances of the best steam and electrical skill. From that station the current will be conducted by lead covered insulated copper cables laid in conduits, constructed under your supervision and direction. From these feed mains will be conveyed similar cables through subsidiary or distributing ducts, provided with handhole openings below the pavement at every house line. From these handhole openings will be similar cables laid in ducts beneath the ground to the house or vaults if there be any under the sidewalks. Against the cellar wall or in the coal vault under the sidewalk, as the case may be, will be placed our converters. This converter, by its construction, converts or reduces the electromotive force which it receives to any given pressure that we may desire, never exceeding one hundred volts and being ordinarily but fifty volts. This converter may be likened to a reducing valve upon a steam conveying line, such as is frequently used in many buildings in this city and elsewhere, where the boiler plant is required to be at a high pressure for the purpose of running engines and other machinery, which requires high pressure, and at the same time to provide steam at a low pressure for heating rooms. We suggest this comparison in order that persons unfamiliar with electricity may be able to comprehend what is meant by conversion or reduction of electricity.

We present herewith for your inspection and examination one of the converters such as we intend to use. An examination of it will show that the assertion that "between these two circuits is interposed nothing more than a thin layer of cotton and silk insulation," is very wide of the fact. This assertion is followed by another that "as has happened again and again, it requires but a flash of lightning or little moisture in the converter to bring the death current to each lamp." Both assertions seem to have been made in ignorance of the fact that this very converter which we show here, and whose construction you can so readily understand, is full of the strongest elements of safety against the danger which he suggests as liable to occur from a flash of lightning, and is a source of safety in the alternating current, and is entirely absent from the system lauded and approved of so highly by the author of the assertions. This converter has been by an advocate of the continuous current, called a lightning arrester. Those who are informed, know that before it would be possible to bring the death current of a flash of lightning to each lamp, the converter must be entirely destroyed, and there must be a termination of the death current, as it could not pass through the destroyed converter, for there would be nothing by which it could pass. Whereas, in the direct current system nothing interposes to prevent the continuous passage of a lightning flash to each lamp, but the suggestion as to a flash of lightning, if it be entitled to consideration in any way, has no bearing manifestly to underground wires, and we wish to use nothing else.

In addition to the converter for reducing the voltage which we carry in our mains are safety fuses, which, should a current possibly pass beyond the converter, exceeding the voltage we desire to have in the house, would instantly fuse and break the circuit, beyond which the current could pass; but, assuming that the current, in all its intensity of the mains, should pass this converting apparatus in its full pressure, and should fail to dissolve the safety fuses, and should pass along the conductors to the lamps, then again would the circuit be broken at each and every lamp. Then in order that every danger—not of death but of shock, could occur to any one, it would be necessary to take hold of both wires—and they should be bare at that, while those we use are thoroughly insulated, in order to obtain a current through him and to the ground.

In all of our wiring we use as a matter of business economy the highest class of insulated wire, carefully made to undergo any test that can be reasonably asked for by any expert. This insulation thoroughly protects every particle of wire from our station to each and every lamp and renders it absolutely impossible for any one to come directly in contact with the bare wire except in possible cases of accident, such as fire in the building or similar circumstances, which would disrupt every connection made by us. In such cases, in order that any danger of any kind should occur to persons within the building, it will be necessary, as heretofore stated, that the current pass in its full intensity through the converter, unreduced and untransformed, and that the safety fuses fail to melt, and that the person take hold of both wires in order to complete a circuit. The probabilities of this series of concurrent circumstances occurring are, as is evident from the facts of the case, almost unlikely. All persons who have received shocks from the alternating current, have been those employed in or about the stations, whose duties took them to the switchboards or to the wires connected with them directly from the machine, and even these have not suffered more than a temporary inconvenience.

We use an electromotive force of 1,000 volts in our mains for the purpose of conveying current long distances, avoiding thereby the placing of generating stations in many parts of the city. Generating stations, as well as any similar establishments, are not desirable to the residents of largely inhabited neighborhoods.

With our lead-covered insulated copper cables, which can be laid in the earth or in specially constructed conduits with equally good results, and with an electromotive force of 1,000 volts, electricity by our system, can be served underground as readily as gas or water.

With generating stations situaed on the river front, such as the one we are constructing, and the conveyance of the current underground, as we desire, to have customers in the thickly populated districts of the city, very large benefits to the city in many directions are accomplished, and no detriment in any respect can be shown. The application of the rule proposed is therefore manifestly as unwise as uncalled for.

In proposing this rule, accompanied by such violent arraignment of the alternating current and reckless disregard of the history of the system we will use, the proposer, if he sought to benefit rather than to wrongfully alarm the public, should have given facts if he had any, derived from individuals capable of honestly deducing and stating facts from their experience, which would justify the adoption of any such rule.

We have not wished to promote any discussion between the respective merits of different systems of electric lighting; neither have we undertaken to illuminate the electrical record of the party whose name is suspended to the publication in question, nor to indicate the reasons for the prejudice thereby displayed against every system except the one in whose behalf the diatribe seems to have been prepared. But we deem it proper to say in view of the facts we have given concerning the Westinghouse alternating current system, which proves that the alternating current is not a "damnable and fatal" current; that the paragraphs preceding the proposed rules were uttered by one who was doubtless entirely ignorant of the system we will use, and who, consequently, if of honest purpose, should have refrained from such indiscriminate epithetic denunciation of the alternating current. Or, if he were fully informed, as assuredly he should be in assuming to give promiscuous electrical instruction, unless he is one of that innumerable caravan who boldly "rush in where angels fear to tread," then he sought for some certainly not honest purpose, to mislead and disturb the public mind by the use of alarming adjectives and misstatements, which, instead of facts, comprise all that we can find in his document concerning the alternating current.

We are well pleased, however, that your honorable board has made use of this publication as a vehicle for obtaining an intelligent discussion of this subject, for we know that the result must be that you will with pleasure approve the Westinghouse alternating current system, such as we propose to use, as being excellently adapted to meet the growing necessities of our city for electric lighting. And that you will, in the interests of the public, set aside suggestions emanating from ignorance or malevolence and discountenance assertions which vary so widely from the experience of so many.

Very respectfully,

THE SAFETY ELECTRIC LIGHT AND POWER COMPANY,
WM. H. BROWNE,
Treasurer and Manager.

COMMUNICATION OF SEYMOUR G. SMITH.

To the Board of Electrical Control, New York City:

NEW YORK, July 14.—We are in receipt of a marked copy of the minutes of your board containing rules for station lighting proposed by one Harold P. Brown, electrical engineer, and at your invitation we would submit the following considerations upon the subject:

The author of the article printed in the *Post* and of the proposed rules and regulations is a professional electrician and inventor, and as we are credibly informed, is now in the employ of a company which uses what Mr. Brown terms a "closed circuit armature" for its generators. If we are right in this supposition the constructor of the rules and the author of the arguments advanced in the article cannot be supposed to be free of bias. We think it proper to call the attention of your honorable board to these matters because it seems evident to us from the whole tenor of the printed article that it is an attack upon all other systems of electric lighting and distribution which could by any possibility be rivals of the system with which Mr. Brown is identified, and that some of the rules suggested are made rather with a view to injuring rivals than with a purpose of protecting the "dear public."

As Mr. Brown subscribes himself an electrical engineer, and as your board has seen fit to take notice of the article, it is fair to presume that the profession of the author has carried some weight with your board in inducing it to submit the rules for the consideration of other companies with a view of possibly adopting them. In that view of the case it would seem not improper to inquire whether the knowledge of Mr. Brown as displayed in the article is such as would entitle him to credit as an electrical engineer.

In historical matters alone an inaccuracy is displayed with regard to the art which at this day is hardly to be expected of any of Mr. Brown's profession. For instance, it is stated that "open circuit armatures" were pioneers in electric lighting and that at the time they were invented it was supposed that the "closed circuit armatures which produce the steadier and safer current could not be made to develop sufficient electromotive force to operate a number of electric arc lamps upon one circuit." The fact of the matter is that the machine with the closed circuit armature, which is known as the invention of Gramme, was one of the first types of machines to be employed in arc lighting. The Siemens machine as used for arc lighting is another case in point, as also the system exploited by Wm. Hochhausen in this section in 1878 and 1879. The fact is so well known to electricians that further statement is not necessary.

Mr. Brown has further attempted in his article to draw a distinction between what he terms the "open circuit armature" and "closed circuit armature" in regard to the nature of the current, and the closed circuit armature being commended because it is supposed to produce a perfectly smooth current, while the open circuit armature is condemned on the ground that it produces a "pulsating" current, and that the current produced by it is the same as that of a medical battery having an induction coil and a circuit breaker in the primary. There is no similarity in fact whatever between the currents produced by these two devices.

Your board's expert will tell you that an "open circuit" armature never breaks the circuit for the lamps or other devices, and that there cannot therefore be a current of the same nature as that produced in an induction coil where the primary circuit is absolutely broken. The current of the "open circuit" armature, it is true, pulsates slightly, as does also that of the "closed circuit" armature, but the extent of each pulsation is not in either case the whole pulsation of any one part of the armature, but a tendency to pulsation is counteracted by the fact that while the current in one coil is rising or falling, as the case may be, the current in other coils connected at the same time to the circuit is rising or falling and the resultant effect is a current very nearly uniform. In some machines the tendency to pulsation is further counteracted by what is known as an electrical or magnetic inertia of the armature which causes a prolongation of the currents so that the lapping of the currents upon one another is extended, and the sharpness of pulsation reduced.

There is not, as Mr. Brown would have the public understand, the difference in danger which he assumes between the use of a "closed circuit armature" and an "open circuit armature." The records of deaths do not support his views, and if there be any difference in the number of casualities we believe that it will be found to be due to the difference in the electromotive force of the machine employed, or to the predominance of the systems using the "open circuit armature." The closed circuit armature as at present constructed does not lend itself so readily to the production of high electromotive force, and the running of a large number of lamps in series; at any rate such has been the history of the development of the art. The open circuit machines have been practically constructed so as to run more lamps in series, while the companies using the closed circuit armatures have found difficulty in making successful and reliable machines which would run arc lights in series up to the number which it is possible to employ with the machines of their rivals. There seems to be no doubt that there is a limit of electromotive force and quantity of electric current which can be passed through the human system without producing fatal effects. Just what that limit is with what particular kind of current is not established, and it certainly is not established that any particular kind of current is necessarily more fatal than an other. No conclusion on this subject can be drawn from the effects, produced by an ordinary induction coil, the nature of whose secondary current differs so greatly from that of arc lighting circuits. If electromotive force or tension were the quality alone which determined the injurious effects of an electric shock the ordinary induction coil should be far more fatal in its effects than the ordinary electric light current of even 3,000 volts, inasmuch as the electromotive force of the current from the secondary is, as is well known to electricians, enormously greater. The voltage of the alternating current which would be used in practice is like that of the present arc light currents, far below that of a medical induction coil, and there is even reason for supposing that the alternation of current would tend to prevent destructive effects, each current tending to undo the work of its predecessor.

The rule as to the quality of insulation to be used for outdoor arc circuits we see no objection to, and this company in fact takes particular care to run circuits of the quality demanded by the rule.

The third article provides that no arc dynamo shall be operated unless provided with a voltmeter to provide a path for the extra current of the field magnets on the opening of the external circuit. We see no reason for the adoption of this rule In the first place, the condition which this rule is intended to provide for, can only come about by the exercise of the most culpable carelessness on the part of the linemen in introducing their bodies into the circuit of the machine. The same order of intelligence which in a lineman would lead him to take hold of an electric circuit and then break the circuit between his hands, allowing his body to be inserted, would lead him, like the proverbial Irishman, to cut the limb on which he is standing between himself and the tree

Again, it is not practical to employ a voltmeter or resistance which would be reliable in operation in the manner proposed with destroying the efficiency of the system.

Thirdly, it is not conceivable that an appliance such as proposed could be used which would operate before the

effects of the extra current would be felt and would do their work upon the victim

The fourth rule, if it can be satisfied by practical means, is to be commended.

The expedient proposed by Mr Brown, of a constant earth connection at the station, is not practicable, and we do not know how such a requirement of the rule could be satisfied. There can be no question but that the introduction of the ground connection would introduce an element of weakness into the system, and would simply invite the production of the dangerous conditions which it is the object of the rule to eliminate We would state here that it is the practice of this company to employ frequent and careful tests of its line for determining whether there is a ground connection of the circuit. The application of this test at frequent intervals is sufficient for all practical purposes, but the establishment of the permanent ground connection would not be permissible, inasmuch as it would simply invite the introduction of dangerous and objection able ground connections at other points of the circuit

The condition provided for by the fifth rule is so remote that we do not believe there is any occasion for enforcing the use of apparatus such as proposed, and we would at this point suggest to your board the advisability of inquiring whether the special devices suggested by the third and fifth rules are not covered by patents or applications for patents, so that the enforcement of the rule in the manner proposed would put it in the power of the company owning such inventions to make all its rivals pay heavy tribute.

As to the fifth rule, we would say further, that the ordinary indicating appliances in use at present on arc light circuits are sufficient to indicate immediately the rupture of an external circuit, and that under such conditions the machinery should be stopped. If, despite the indications which are present at the station, the person in charge would continue to run the apparatus, he would do so despite the provision of a device such as suggested by the rule. We would say further, that in the behavior of the machinery at the station an indication to the skilled attendant is given of the condition which the rule is intended to provide for It is not conceivable that the wires at present in use should break, and that both broken ends should fall into connection accidentally with a conductor with which they would make sufficiently good contact to permit the apparatus at the station to operate normally. The breaking of an ordinary circuit wire, such as at present in use, is in itself a contingency so excessively remote as to hardly warrant consideration. It is a contingency, at any rate, that is sufficiently provided for by a provision as to the tensile strength of wire which a company should be permitted to use

This company operates its lines with No. 4 wire, the strength of which is amply sufficient to prevent breakages under the most adverse conditions.

The sixth rule, with regard to the electromotive force permissible in systems employing alternate currents, is simply prohibitory of the use of such systems. There is not, even under the most unfavorable view which can be legitimately taken, such a difference in the danger from the use of alternating currents and continuous or ordinary arc light currents, as to warrant the requirement proposed under these rules.

The first of the suggested rules allows an electromotive force of from 2,500 to 3,000 volts in the case of ordinary arc light currents. The last rule practically allows but a tenth of that voltage in the case of alternating currents

It is no more than right that your board should take notice of the fact that there has been a systematized attack upon the alternating system by its business rivals, and for that reason alone any objection to the system should be received without hesitation. The practical commercial advantages of the alternating system are such that it cannot be suppressed. The progress of development of the art of electricity is unquestionably in the line of alternating currents and for reasons which all electricians will recognize.

Recent inventions have made it practicable to operate electric motors from alternating currents without the use of commutating or circuit changing devices of any nature whatever in the motors. The importance of this attainment can hardly be over-estimated. It enlarges at once the field of electricity as a distributor of motive power, a fact which certainly should not be overlooked in a city like New York, where so many large manufacturing interests are located.

This company believes that alternating current electric motors without commutators or circuit changers of any description are a practical thing, and the use of such motors on an alternating current system forms a part of the contemplated business of this company with reference to which it was organized and obtained its charter. Such business must form a large and profitable source of income to every company which shall either purchase or acquire the right to use motors of this description.

The field for the industrial applications of electricity has within the past two years broadened in other directions beside in the matter of motive power. There can be no doubt but that electricity as a heating agent in welding, forging, shaping, and in almost every variety of metal working operations will be largely employed in the near future. This application of electricity has recently been developed in such a manner that this company will undoubtedly make a rental of machines for welding, shaping, brazing, soldering, etc., by electricity, a part of its business In the practical distribution of electricity for this purpose, the alternating current is the sole and effective one, because it allows of the location of converters at any place, and of a character requisite for producing the large volume of current required in welding operations. It is not possible to supply current of a volume required for metal working operations by the direct system of distribution, owing to the enormous cost of the supply conductors.

There is no reason to doubt but that electricity will be used on a large and extensive scale within a short period for almost every business where a working or joining of metals in any way by heat is performed as a part of a manufacturing operation. It is a part of the business of this company to supply electricity for this as well as other purposes, and it cannot practically do so if the restriction proposed by the rules is placed upon the use of alternating currents

The domain of electricity enlarges from year to year, and all indications point to the increased use of alternating currents, because of the fact that the generators are simpler; that the electrical energy can be readily localized when it comes to the question of distribution, and that the system possesses undoubted advantages in the flexibility and ease of installation which cannot be gainsaid. We do not think that it is an advisable thing in a city like New York, where the business and manufacturing interests are so large to impose restrictions such as proposed by Mr. Brown.

The objection made in the article of Mr. Brown, that the alternating current cannot be introduced into houses because of the fact that there is only a thin layer of cotton or silk insulation between the secondary an primary, is effectually disposed of by the application of a permanent low resistance ground to the secondary circuit, which would effectually dispose of the objection that a flash of lightning will bring the "death current" to each lamp This is an expedient which this company proposes to introduce into all its alternating current apparatus, and with the provision of proper insulation of the main conductors, both in the coiterter and in the connections throughout, there is no reason whatever why the system may not be used with as great security as any of the ordinary electric arc systems. Respectfully submitted.

THE EAST RIVER ELECTRIC LIGHT CO , BY SEYMOUR G. SMITH President.

Operating the Thomson-Houston System in New York.

The following affidavit made by W. L. Wright, was presented:

AFFIDAVIT OF W. L. WRIGHT.

PHILADELPHIA, } s.s.
CITY and COUNTY, }

William L. Wright, being duly sworn according to law, deposes and says, on the fifth of August, 1887, I was in the employ of the Keystone Electric Light & Power company in Philadelphia, Pa., and had occasion to do work in the cellar of the building at Eighth and Chestnut streets, Philadelphia, occupied by Castor & Co. The electric wires in the cellar upon which I went to work had been until a few days before used for a 200-volt three-wire direct current system, and a socket had been attached to them by means of a long flexible cord to give a temporary light in the cellar. The wiring had there been changed and connected to the 1,000 alternating current, and forgetting that this current would be on the socket, I took hold of the socket while standing on the wet ground, when I received a shock which threw me on my face with my hand underneath me and still grasping the socket. I have been accustomed to handling high tension currents and knew I was in danger, but was not able to call out to the man who was with me. I retained consciousness for some time but was gradually rendered insensible. When I came to my senses I was sitting in the cellar held up by two of the men. In the meantime an ambulance had been called, but I refused to go in it, as I did not feel in any way injured except that my hand had been badly burned. I went down to the electric light station and waited there fifteen or twenty minutes to receive my money, it being pay-day, and then went home. At the urgent request of the officers of the the company I went to see Dr. Horace Williams, 1717 Pine street, Philadelphia, who dressed the burns on my hand. These burns healed very slowly but I have not felt in any way any of the after effects from this shock such as are usually felt from high tension direct current machines. I am familiar with arc light currents and have received in my business many severe shocks, and I feel sure that had I received this kind of a shock from a direct current machine of any of the ordinary types * * * it would have been fatal.

I have worked with the alternating current both on the primary or high tension wire and the secondary or low tension wires and am familiar with the placing of converters in different situations throughout buildings, and when placed as they are placed in Philadelphia, under a proper set of rules such as the Board of Fire Underwriters have approved in Philadelphia I do not see how any one can be hurt on the secondary wires, as in case of any accident the safety fuses in the high tension wires melt out immediately, and I think that the high tension wires when properly boxed in are a great deal safer than arc wires can possibly be.

And further saith not.

[Signed] W. L. WRIGHT.

Sworn and subscribed to before me this seventh day of July, A. D. 1888.

THOMAS D. SIMPSON, Notary Public

Other affidavits to the same effect were presented, signed by:

John Klepper, Benjamin Acker, Albert Schmid, George Fulton, John Schwartz and C. J. Thompson, all of whom had received shocks from 1,000 volt currents.

At the request of the board, T. Carpenter Smith explained the underground system, as used by the Westinghouse company in Pittsburg, and in reply to an inquiry by Commisioner Gibbens, said that he considered the subways in New York superior to those used elsewhere in this country. He then dissected a converter for examination by the board, showing that the statements made by Mr. Brown as to its insufficient insulation were erroneous. President Hess then called for the opinion of H. P. Brown, or any other person who desired to appear and argue against the introduction of the alternating system in New York city, but there being no person present who desired a hearing, the meeting was declared adjourned, subject to the call of the chair.

CORRESPONDENCE

New York Letter.

NEW YORK, July 27.—Although the construction of subways is not attracting so much attention this season, the work is being steadily carried on, under the auspices of the Phoenix Construction company. The section on Broadway between Forty-fifth and Fifty-ninth streets is just completed. It is an extension of that completed last year, and consists of a line of ten ducts on each side of the street, those on the east being for telephone and telegraph service and those on the west for electric light and power service. Other sections completed this season are as follows: Stone street, between Whitehall and William; on William, between Exchange Place and Front; Pearl, between Exchange Place and Frankfort; and on Frankfort, between Park Row and Water street. The latter is for the accommodation of lines to Brooklyn which will run to the East river bridge from this point on Water street. The Sixth avenue subway has been extended south from Ninth street to Spring. Short sections have been completed on West Houston street, between Green and Downing streets, on East Houston street, between Chrystie street and Broadway, and on Spring street, from the telephone exchange to Broadway, the latter containing fifty ducts. A conduit has been laid on Spring street, between South Fifth avenue and West street. A line on Lexington avenue containing thirty ducts is nearly completed between Fifty-eighth and Sixty-fifth streets. Work is in progress on Broadway from Vesey street to Union Square on the west side of the street. Nothing will be done on the east side for the accommodation of electric light wires until it is decided whether the companies can be compelled to place their wires in them, as the amount of capital necessarily sunk is too large to remain idle until the litigation is ended between the Board of Electrical Control and the United States company. The material used for the subways differs in different localities. Ducts are made of wrought iron pipe embedded in hydraulic cement, and also of sheet iron lined with cement, as no trouble was experienced with either of these plans which were adopted very generally last year. Square sticks of yellow pine eight feet in length, with a duct bored through them and treated with creosote, are also used to a considerable extent. The requisite number of these "pump-logs" are assembled together and boxed, and it is thought they will answer the purpose very well. The telephone company is placing its cables in the subways as they become available, and underground telephonic communication is now established between the Pearl street exchange near the Battery and Fifty-ninth street, a distance of nearly five miles.

On Wednesday Police Justice Gorman made a formal decision in the case of the Board of Electrical Control against the United States Illuminating company for maintaining wires and poles in certain streets contrary to the rules of the board. The case is allowed to take its natural course, and the company is held to await the action of the grand jury. If an indictment is found against the company, a vigorous fight will ensue. Justice Gorman dismissed the complaint against the company for maintaining a nuisance.

The date of the annual clambake given to the electrical fraternity by the American Electrical Works at Providence, has been fixed for September 1st, between the meetings of the electric light and the telephone associations in this city. A movement is on foot to charter a steamboat for the occasion, to call at Newport on the return trip, and make the excursion a continual round of pleasure. Some doubt is expressed as to the possibility of the average electrical constitution enduring such a strain as this programme implies.

A few days ago Manager Tillinghast of the Western Union office at Buffalo, N. Y., expressed the opinion before the city fathers that the authorities should take some steps toward putting the wires of the city departments underground, before calling upon the various electrical companies to do so. This argument has been offset by the announcement that a contract has been awarded to the Standard Underground Cable company to furnish 85,000 feet of lead-covered cable of varying capacities for use by the fire department in that city. The work thus begun, will no doubt be continued until all the municipal wires are buried.

It is expected that the new station of the Westinghouse company, corner of Twenty-fourth street and Thirteenth avenue will be ready for occupation on October 1st, with 1,000 horse power for the supply of incandescent lighting by the alternating system in the district between Eighth and Fifty-ninth streets. All of the conductors will be placed under-ground, and the subways provided by the Consolidated company will be used wherever available. If no conduits are ready in the streets which it is necessary to pass through, the company will provide its own under approval of the Board of Control. P.

Indianapolis Items.

INDIANAPOLIS, July 26.—By its action Monday night the city council tied the city up in a three years' contract with the gas company. The light committee reported 668 street intersections inside the city limits. At present there are 2,664 gas lamps in use, which the Gas company now agree to light on the 2,740 hour schedule for $15.43 per lamp or $40,982. These lamps represent about 533 Thomson-Houston lights, 533 Brush lights, or 666 Jenney lights. The committee recommend that the mayor enter into contract with the Gas company to light all gas lamps at present in use, and such additions as may be called for from time to time at the rate of $15 per post, the city reserving the right to extinguish a certain number of lamps, to be designated by committee of council and aldermen and city engineer, in the central part of city. In place of the abandoned gas lamps they propose to use electric lights to the number of 100. They also recommend contracting with the Brush Electric Light company for 100 lights to be lighted every night, all night, at rate of $60 for each lamp per annum, to be located as directed by committee. The report was adopted by a vote of 13 yeas, 11 nays.

It was claimed by several members of the council that the Jenney company's bid for lighting the whole city, furnishing all lights necessary, for $39,000, was not to be depended on. The Jenney company prepared and presented a communication, stating they meant to do just what their bid called for, light all streets and alleys, place the lights at any and all points designated by council. In evidence of its good faith, it offered to give a bond of $50,000. From the first it was evident the committee were in favor of gas; probably nothing the electric light companies could have done would have changed matters. The board of aldermen immediately convened and concurred in the action of the council, though not without some sharp debate.

By its action the council have pretty effectually shut off any prospect for competition in public or private lighting. With the contract for lighting the city, as a backing, an electric lighting company would have been a competitor for lighting public and private buildings, etc., that would have improved the quality of light and no doubt, lessened the cost. It has been asserted, and one or two of the city papers published statements that the gas company and the Brush Electric Light company had combined to secure the contract and shut out competition. This was denied by the president of the Brush company of this city. One thing is certain, the city has settled the question at a cost of nearly $10,000 more than one of the electric light bids. Nor is this all. There are miles of streets which are not lighted, but whose residents are clamoring for light, and it's only a question of time when they will have to have it.

The Dudley electric Street Railway company notified the city authorities of their acceptance of the ordinance and filed necessary bond and papers. This company and the Citizens' company appear to be watching each other closely, as by dark Tuesday night each had gangs ready and went to work laying track on South Meridian street, the Dudley company laying track for one square between Washington and Maryland streets, while the Citizens' company began between Maryland and Georgia with the Dudley on next square south; both companies worked all night and during Wednesday had gangs on different streets along proposed routes, each putting down patches of track. It promises to be an interesting fight. M.

Electric Light in Buffalo.

BUFFALO, N. Y., July 24.—"Angry Aldermen" is the *Express* caption of that paper's report of the city council meeting yesterday The bone of contention was Mayor Becker's veto of a resolution adopted July 9th, granting a petition to have East and North Parade avenues, between Genessee street and Avenue A, lighted with electricity, and directing the comptroller to contract. The mayor says that there is not, in his opinion, any necessity set forth in the petition, and consideration is therefore confined to the cost of maintaining that quality of light. The resolution would permit three lights to be placed on the two avenues, at a cost of $520.12½ per year, at the present contract price, while the lamp tax this year upon all of the property fronting on the two avenues was $25,70, or less than five per cent. of the cost of the three lights. The following five paragraphs are quoted from the mayor's communication to the council:

"Electricity is undoubtedly the best medium now in use for street lighting, and it is also true, in my opinion, that the city is paying an exorbitant price for gas; but the present price of electric light is so much greater than that of gas that its general use is in my opinion a detriment to the growth and prosperity of the city.

"I have approved and recommended the use of electric lights in our much traveled thoroughfares and about the railroad crossings and other dangerous places, but extensions have from time to time been urged and crowded by the different companies in a manner and to an extent that is not only burdensome but shameful and outrageous.

"Citizens whom we consider reputable have become interested in the various companies and with this community of interest and what they probably term business enterprise, have woven about your honorable body a chain of influence that seems to cause you at times to forget the interests you represent.

"We have paid nearly a million and three-quarters in money raised by taxation for the construction of so-called coal railroads in order that we might have cheap fuel; and now being a great coal market there can be no good reason why steam power cannot be produced here as cheaply as at any point outside the coal region. Yet out of sixty-eight leading cities using electricity generated by steam power, forty-six of them pay less for arc lights than we are now paying, while only three cities use a greater number.

"The use of incandescent electric lights in resident streets may be worthy of some consideration, and I have reliable information from the neighboring city of Rochester that they are considered a valued substitute for gas and that a 20-candle power light costs but $18.25 per year, or $4.39 less than we now pay for gas lamps."

The observations made by several aldermen were more explicit than complimentary. One said the mayor's veto was "quite a stump speech." Alderman Scheu insisted that electricity is cheaper than gas, even on Niagara street, where so much is used. As the mayor said, gas is very high. It is not worth $1, and the gas companies do not even keep their lamps clean. He wanted to know if gas would now be obtained for $1.35 if it were not for electricity, which had reduced the price of gas from $2 to $1.35. The lamp tax was decreasing every year. "The introduction of electricity," said the alderman, "has been the means of saving the city millions of dollars. I believe that if the whole city was lighted to-day by electricity, as Rochester is, it would be cheaper under the contract than gas." Alderman Adams asked that the gas inspector report as to the superiority of electricity over gas, as well as the difference in cost. "The city must expect to pay more for electric lights than for gas, because they are better. If not, then the city ought to use tallow candles, which are cheaper than anything else."

In order to show that he had no personal motive in continually objecting to increasing the number of electric lights, the mayor stated that his business firm owns $5,400 of Citizens' gas stock and $12,000 of Thomson-Houston electric stock "all of which stock was paid for in cash." The matter was ultimately referred to the committee on lamps. H.

From Erie, Pa.

ERIE, PA., July 27.—The Belt Line Street Railway company, recently organized in this city by eastern capitalists and a few citizens of Erie, has applied to the city councils for the right to lay tracks along the street and to erect poles upon which to place wires for the overhead electric system. The street car company at present running their cars with horse power, has also made application to the city authorities for power to construct lines to be used for operating their cars by electricity. Neither company has yet been given the authority asked for, though it is probable it will be given.

One branch of the city councils has directed the city attorney to draw up an ordinance directing the Western Union Telegraph company to place its wires on State street underground. This action, it is said, was the result of the refusal of the Western Union company to allow the street car companies to place wires upon the poles of that company along State street.

The Edison Electric Light & Power company in this city, which now has over twelve hundred patrons and is steadily increasing the number, and which is furnishing power for running a number of motors, is erecting new lines of poles for the purpose of stringing wires for lighting private residences by incandescent lights. One daily and one weekly paper run their presses by electric motors, the power being furnished by this company. F.

From Kansas City.

KANSAS CITY, MO., July 27.—The city council is finally at work on the telephone matter. A committee has been appointed to make a thorough investigation of telephone rates, expenses, profits and the business generally not only here, but in all the cities of any considerable size. So far only two replies have been received to letters of inquiry sent out by the committee to other cities. One is from St. Louis explaining the well-known condition of affairs there. The other is from Omaha. There the rate is $5 a month for the instrument and 50 cents a month for each quarter of a mile or fraction of a quarter that the instrument is distant from central. For three-quarters of a mile this would be $78 a year, while in Kansas City it is only $72, which is the amount charged in Omaha for a half mile.

The Home Signal Telegraph & Messenger company has separated from the Pacific Mutual Telegraph company for which it has heretofore carried messages, free of charge to the sender. It is now performing that service for the Western Union. George M. Meyers is the controlling spirit in the Home Signal company it is understood, and until the late reorganization he was general manager of the Pacific Mutual. He has now disposed of his interest in the Pacific Mutual, and hence was open to an offer from the Western Union. The Pacific Mutual is establishing a call box and messenger service system of its own.

George W. Conover, formerly assistant general manager of the Home Signal company, has secured the agency of the Electric Protection Supply company of Chicago for Kansas, Nebraska and Western Iowa.

The United States military telegraph corps of this city held a meeting last week to make arrangements for attending the national convention of the corps, to be held in Chicago next month. All the members present announced their intention of going, and Day K. Smith, J. D. Cruise, and George M. Meyers were appointed a committee to secure transportation rates, and Day K. Smith, J. D. Cruise and H. Lithgow were appointed to urge the convention to hold its next annual meeting in this city. After transacting this business the members organized a branch of the "Old Timers" society, which is composed of telegraphers who were telegraphers twenty years ago, and who have during that period served as telegraph operators for at least three years. John M. Wilson was chosen president; George M. Meyers, vice-president; D. A. Williams, secretary and treasurer.

The Order of Railroad Telegraphers is preparing for its annual picnic at Merriam Park, just west of the city. A big attendance is expected this year.

J. D. Harris, an electrician formerly with Woodhouse & Rawson, London, England, but now with the New York Accumulator company, is now in the city, the guest of the Interstate Electric company.

A man put his hand on one of the underwriters' wires of the Kansas City Electric company last week while it was wet, and now one joint of a finger is missing from that hand. He talks of suing the Electric Light company for damages.

Harry M. Cutler of the Loomis Electric company has taken a trip into Kansas. C. H. Rusling of the Thomson-Houston agency has gone east. E. R. Weeks of the Kansas City Electric Light company has returned from a trip to New York.

The Western Electric Construction company has effected a reorganization. M. D. McQuesten has retired, having disposed of his interests to Ford S. Caldwell, and M. E. Bates has been made general manager. A.

From Ottawa, Ill.

OTTAWA, July 27.—The Mendota Electric Light company propose to run all night as soon as their new station is completed, and becomes a successful competitor of the gas company.

The work of building a new telegraph line along the Chicago, Rock Island & Pacific railway, between Ottawa and Normal Park, Ill., a distance of seventy miles, was begun July 16th. The lines will be built upon the south side of the track. The poles will be thirty feet high, with three four-pin cross arms, and will take the place of the two old lines of poles now in use. Two new No. 6 wires will be strung, one reaching Peoria and the other St. Joseph, Mo.

The electric lights for the bridges and Washington Park have been put in place, and are a decided improvement over the old gas service.

The people of Earlville, Ill., are making a move to secure the building of a telephone line connecting with Ottawa, a distance of eighteen miles.

The $100,000 capital stock of the Ottawa Electric Street Railway company has all been taken in amounts as follows: T. P. Bailey, $50,000; Thomas J. Evans, $24,000; W. J. Clark, $24,000; G. S. Eldridge, $1,000; W. S. Bowman, $1,000. The first board of directors is composed of Thos. J. Evans, Council Bluffs, Ia.; W. J. Clark, Birmingham, Conn.; T. P. Bailey, Chicago, Ill. The officers elected for the ensuing year are T. J. Evans, president; W. J. Clark, vice-president; T. P. Bailey, secretary and treasurer; G. S. Eldridge, attorney. The equipment for the road has been ordered from the Thomson-Houston company. At a special meeting of the Ottawa city council, July 19th, the Ottawa Electric Street Railway company was granted a franchise. The vote was unanimous. About two miles of the road will be in operation by December 1st, next; the remaining four miles by June 1, 1889. E.

News from Little Rock.

Little Rock, Ark., July 27.—The City Electric Street Railway company began operations the first of this month. There is nothing electrical about the road at present except the name, but they intend at some time in the future to use electric motors. The city advertised for bids a second time for lighting the city by electricity, and the Fort Wayne Jenney company captured the contract again, at the same price as before ($27,000.) For this amount they will furnish the necessary plant, lamps, towers, etc., and the city will operate the station. Towers are to be erected at different points, and the main streets will be lighted by arc lamps at every other block. Work is to be begun at once.

The Little Rock Edison Electric Light Power company has been organized. The company has purchased of the Edison company a plant capable of running 1,200 incandescent lights. A large number of the lamps has already been contracted for by firms in the city, the Capital theater being among them. The plant completed and in running order will cost $20,000, and will be enlarged as the business demands it. The company will at the next meeting of the city council apply for a charter from the city, and just as soon as that is granted work on the new enterprise will commence. The gentlemen interested in the concern are Messrs. Hornibrook & Townsend, Angelo Marre, W. O. Thomas and Electrician McGregory, who feel confident that the scheme will be quite an acquisition to the many other enterprises of the city of Little Rock.

Tired of waiting for the organization of a company, Hiram Robbins, proprietor of the "Delacatesen," has installed an incandescant plant of his own. He has a 50 light Edison dynamo run by a Charles P. Willard six-horse power engine with an eight horse power boiler of the same make. He now has about 30 lamps burning, and will have 42 when all are placed. He also furnishes current for 12 lamps for a drug store next door, and could furnish two or three hundred in the neigh- borhood, if he had the power.

A.

Notes from Kansas Towns.

Hiawatha, Kan., July 27.—The 36 arc light plant is in successful operation, and the company is endeavoring to put in a 600 light incandescent plant. Bids were advertised for, and seven were received, all of which were rejected and new ones asked for. It is thought the system will be the Edison-Westinghouse.

Wichita, Kan., July 27.—Patrick McDonald, a young farmer, who lived about eight miles in the country, was struck by lightning last week, and instantly killed. He was riding on a reaper returning from harvesting when struck. The horses were slightly shocked, but the reaper was uninjured. The only mark upon McDonald's person was a small purple line just above the eyes.

Chetopa, Kan., July 27.—The Western Engineering Electrical company of this city, has increased its capital stock to $20,000.

Marysville, Kan., July 27.—The Brush Electric company of Cleveland, is putting in an electric light plant here, the contract having been secured by the Kansas City agent, O. C. Steele. The Southwestern Electrical Supply company of Kansas City has the contract for furnishing the poles, wire, tools and general supplies.

D.

From Nebraska Towns.

Lincoln, Neb., July 25.—Agent Ziemer of the Burlington & Missouri no longer maintains a public telegraph office. The Western Union wires and desks have been removed to the office of the telegraph company. This is the tardy result of an agreement entered into between the Burlington & Missiouri and the Western Union several years ago. In the early years the Burlington conducted an independent telegraph business in Nebraska. Three or four years ago it was sold to the Western Union, but before the transfer was fully made, some question as to the terms of the sale arose and the Burlington refused to turn over all the offices. A short time ago the differences were adjusted and now all the Burlington commercial telegraph offices have been absorbed by the Western Union.

Hastings, Neb., July 24.—The Nebraska Telephone company contemplate doubling its capacity in this city. At the present time the company is obliged to put off orders until a new switch board can be put in. The capacity of the Thomson-Houston plant is to be doubled.

Kearney, Neb., July 27.—The Kearney Canal & Water Supply company is getting the various parts of its mammoth plant in readiness for operation. The water supply is brought in a canal thirteen miles from a river down a steep grade, and besides furnishing water gives enough power to operate an electric light system and an extensive system of electric motors, still leaving 2,500 horse power for lease. One 30-horse power and one 20-horse power motors are now in operation as well as forty Thomson-Houston arc lights. A 1,000-light Edison incandescent plant is being installed and arrangements are being made for the electric motor circuit. The contract for wire, tools and general supplies for the work has been let to the Electrical Supply company of Chicago through its Kansas City agent, C. H. Cone. The contract calls for P. & B. wire.

Omaha, Neb., July 24.—The Omaha Electric Light company have had an ordinance before the council for some time providing for a twenty-five year franchise and a five years' contract with the city for street lighting. It met with strong opposition in the council and has finally been withdrawn. An ordinance has also been introduced granting a franchise to John Grant for laying electric wires underground.

Seward, Neb. July 27.—The electric lights recently put in here are proving so satisfactory that the citizens are considering an electric street railway system.

Sutton, Neb., July 27.—The ease with which bonds were voted for waterworks at the recent election was a complete surprise to the citizens and finding that the desire for public improvements is almost a unanimous one, energetic agitation of the question of establishing an electric light plant has begun.

Fremont, Neb., July 27.—The telephone system has become very popular here. The subscribers now number 125, no small number in proportion to the size of the city, and the list is growing steadily.

C.

Happenings in Missouri Towns.

Cape Girardeau, Mo., July 27.—The mayor and council have under consideration two propositions for lighting the city with electric light.

St. Joseph, Mo., July 25.—An ordinance was introduced in the city council last week, granting the Citizens and Frederick Avenue Consolidated Street Railway companies franchise to operate their cars by electricity. Work on both roads will be begun as soon as practicable after the granting of the franchise. The combined roads have about seven miles of railway, and traverse the principal streets of the city. They have been forced to adopt electricity as a motive power by the wonderful popularity of the Union Street Railway company, which recently adopted electricity as its motive power. The company organized to put in a Westinghouse electric light plant, has secured $65,000 of the required $100,000 and the plant is assured.

Carthage, Mo., July 25.—While John Wilkins was milking a cow, he and the animal were both struck by lightning, but the only damage was the destruction of the milk pail. It was torn, burned and melted until it was hard to say what it had been once.

Excelsior Springs, Mo., July 25.—The accumulator plant in the Hotel Elms, put in by the Inter-state Electric company of Kansas City, Mo , is finally in operation. It is of 75 light capacity.

E.

Des Moines News.

Des Moines, Ia., July 27.—The building for the consolidated Thomson-Houston and VanDepoele Arc Light company is finished and the machinery is being placed in position. The companies will continue to use the two forty-light Van Depoele dynamos, two twenty-five-light Thomson-Houston machines, two thirty-light Thomson-Houston dynamos, and they have purchased two new Thomson-Houston dynamos. They also retain two forty horse power Armington & Sims engines and will put in two 25 horse power engines of the same make. The company recently secured the city contract for twenty-nine lights at $10.50 per month, moonlight schedule. One of the dynamos was recently struck by lightning, and the armature was burned out.

The Edison light company, having about twice as many lights, between 6,000 and 7,000, connected as they could carry if all were lighted at once, are attempting to do little new work.

Mr. Woodruff reports Sprague motors recently installed: For C. B. Atkins, pumping pipe organ in residence; Tilden's shirt factory, running sewing machines; electric fan, for John Sandholm and Norman Lichty's drugstore; Crawford & Finch; F. W. Dean, dentist, and two for E. E. Hughes, dentist. This year will more than double the number of motors in this city.

Mr. Mead of the Telephone exchange, reports 700 instruments in use, and an average increase of ten a month. The American District Telegraph company have ordered a new style of answer-back box with ten calls from the New Haven Clock company.

W.

Des Moines, Ia., July 26.—It is understood that in the last few days the officers of the Des Moines electric railway have taken decisive steps in regard to the electric motors, and that the cars will be running earlier than at first contemplated. Davenport will have electric cars in a few days and Council Bluffs will soon be connected with Omaha by that means of rapid transportation.

Manager Mead of the Telephone exchange reports the service badly damaged by last week's storm and wires were broken down and twisted in every possible way, and about two-thirds of the service rendered useless.

A dispatch from Missouri Valley says: The Inter-State Electric company of Kansas City, Mo., has completed its central accumulator station here and it is now in successful operation.

T.

Denver Doings.

Denver, Col., July 27.—At a special meeting of the board of supervisors, last week, unsigned contracts between the city and the Colorado Electric Light company, for the lighting of the city for five years, were submitted. The electric light company is to light the street corners with 20 candle power incandescent lamps, except the principal streets, where property owners can have arc lights by paying the difference in cost. The railroads and bridges will be furnished with 2,000 candle power arc lights, and there will also be a six-light tower in addition to the six-light tower and four-light tower already in use.

Mr. Seaman, a prominent member of the South Side Electric Light company, said last week, in answer to a query about the proposed plant: "We are to have an independent electric light company. The capital stock is $100,000 in 10,000 shares owned by the taxpayers of the Seventh ward. The system is to be an incandescent one. Lights will be supplied at a nominal cost. You see it is not a money-making scheme. The plant is to be conducted on as economical a basis as possible. We intend to supply about 7,000 lights. It will be a success and work will begin in about thirty days." At a meeting of the company's executive committee, bids for establishing the electric light plant were received from the Fort Wayne Jenney company and the United States Electric company of Chicago. The committee decided to report to the company in favor of the United States company.

A telegram from Pueblo says: "The Pueblo Electric Light company has added seven miles of wire and thirty-six city arc lights to its system. It will put in an incandescent light plant."

G.

Lamp Lighting Schedule. — Moonlight System.

August.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**7 40**	1.30	5.50
2	**7 40**	2.10	6.30
3	**7 40**	3.00	7.20
4	**7 40**	3.50	8.10
5	**7 40**	4.00	8.20
6	**7 40**	4.00	8.20
7	**7 40**	4.00	8.20
8	**7 40**	4.00	8.20
9	**7.40**	4.00	8.20
10	**8.00**	4.10	8.10
11	**8 40**	4.10	7.30
12	**9.10**	4.10	7.00
13	**9 40**	4.10	6.30
14	**10 20**	4.10	5.50
15	**11 00**	4.10	5.10
16	**11 50**	4.10	4.20
17	12.50	4.10	3.20
18	1.50	4.10	2.20
19	No	light.	0.00
20	No	light.	0.00
21	No	light.	0.00
22	**7.20**	**8 40**	1.20
23	**7 20**	**9 10**	1.50
24	**7 10**	**9 40**	2.30
25	**7.10**	**10 00**	2.50
26	**7.10**	**10 30**	3.20
27	**7 10**	**11 00**	3.50
28	**7 10**	**11 30**	4.20
29	**7.10**	12.10	5.00
30	**7 10**	12.50	5.40
31	**7 00**	1.40	6.40
Total number of hours,			157.00

The foregoing schedule is practically good for the United States.

The time for commencing to light is calculated at one-half hour after sunset or one hour before moonset; the time for extinguishing at one hour after moonrise, or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

The Rochester, N. Y., division of the order of Railway Telegraphers was organized with appropriate ceremonies July 26 by the state organizer of the order, C. B. Snody of Albany. The charter members number thirty-one.

THE ELECTRIC LIGHT.

The Key West, Fla., Electric Light company will install an arc plant at once.

J. M. Porter will put up an incandescent electric light plant at Owensboro.

The St. Cloud, Minn., Gas & Electric company is getting estimates for a new $30,000 gas plant.

The Thomson-Houston company has sold a fifty light plant for isolated lighting at Los Angeles, Cal.

The Thomson-Houston company of Chicago has sold a 300 incandescent plant to the new hotel at Fresno, Cal.

The Duquesne Electric Light & Power company of Pittsburgh, Pa., has been incorporated with $300,000 capital stock.

The capital stock of the Consumers' Electric Light company of Chicago has been increased from $100,000 to $200,000.

The Thomson-Houston company of Chicago has sold an arc and incandescent plant to the Topeka Sugar company at Topeka, Kan.

The Cleburne, Tex., Electric Light company's plant is now in full operation, and is affording splendid light to the city and citizens.

At a recent meeting of the Passaic, N. J., council, bids were ordered solicited for purchasing electric lights of 1,200 and 1,800 candle power.

The Oakland Gas, Light & Heat company will increase its plant by purchasing four thirty-five-light arc dynamos of the Thomson-Houston company of Chicago.

A dispatch from Alton, Ill., says: Hugh E. Boyle, representing the Thomson-Houston Electric Light company, has been here figuring preparatory to making a bid for lighting the city, which the council is about to let out.

The Heisler Electric Light company have closed a contract with President Kennard of the St. Louis Exposition and Music Hall Association, for lighting the art galleries, photographic galleries and adjoining rooms with the Heisler electric light.

Prince Albert of Monaco is now coming out in the character of a deep sea fisherman, but not for mere pastime. He is trawling in his yacht, the Hirondelle, along the Atlantic coast, being intent on hauling in rare specimens of the finny tribe in the superior interests of science. A new and improved osier fishing net has been supplied to the Hirondelle, and this apparatus is made more efficient by means of an electric lamp, which will act as a bait and a snare to the fish, just as the candle does to the moth. The apparatus has been invented by Dr. Regnard, who has overcome the difficulties connected with supplying the electric lamp from a generator kept on board the yacht by simply storing the current in an iron case surmounted by a globe, and this is kept in its place at any depth, and is capable of resisting the pressure of immense volumes of water by means of an India-rubber air balloon.

In the English house of commons Sir H. Roscoe asked the first commissioner of works whether, in view of the serious deterioration of the stone fretwork of the interior of the houses of parliament, owing to the corrosive action of the products of combustion of gas, he would undertake to extend the system of electric lighting throughout the building, so as to avoid the evil consequences which attended the present system. Mr. Plunket said that to extend the present system of electric lighting throughout the whole of both houses of parliament would involve a very considerable expenditure, not less than $40,000, for plant. It would, however, probably effect a considerable saving in the annual cost of lighting the palace. Before making any proposals upon the subject, it would be necessary to consider whether some more economical way of obtaining the necessary current of electricity than that which is now used may be made available.

The proprietors of the Hoffman House, New York, have written to Mayor Hewitt and also to the Board of Electrical Control, begging their aid in removing the poles and wires in front of the hotel. In their communication to the mayor they say that they are lessees of valuable property which is endangered by these wires. Their guests are also unsafe, and for their own safety and that of the public they will defray the entire expense of removing the poles and wires of all electrical companies on Twenty-fifth street from Broadway to Sixth avenue. The letter also says that the mayor's reason for not carrying out the work was the lack of funds appropriated for that purpose. It closes with the statement that a check will be at once forwarded to cover all expenses as soon as the order is given. The mayor will reply to this communication by letter, and the Board of Electrical Control will consider the request at the next meeting.

It has been suggested that wind power might be profitably utilized in connection with isolated electric lighting on the storage battery plan, says an exchange. The windmill for pumping purposes has become a familiar landmark on western prairies, and its great economy and effectiveness point to a larger field of usefulness for it. In electrical working of the kind indicated it would apparently appear to great advantage. The power, strictly speaking, would cost nothing beyond first cost of the motor, the expenses of maintenance and wear and tear, and the sum involved in procuring the dynamo and batteries. The necessarily fluctuating character of the power would scarcely be very objectionable, since the energy would be stored whenever available, at intervals perhaps, in comparatively small amounts, a large enough storage capacity being provided, and drawn off when desired. True, there is a heavy loss of electrical energy in all types of storage batteries, but an average return of at least 60 per cent. of the electrical energy put into an accumulation might be expected, and with this a combined windmill and storage battery plant should, in certain locations, offer superior inducements as a means of supplying electric light.

THE TELEPHONE.

There was a fall of telephones in New York last week. Ten cases of telephones containing several hundred boxes and instruments, all new, were being hoisted up the hatchway of the building, 58 Liberty street, when, upon reaching the fourth floor, the rope broke and the whole load fell to the street with a crash, barely missing a truck driver who was standing under. The damage is said to amount to over a thousand dollars, as nearly all the instruments were broken.

The French papers say that microphone was used during the manœuvers of the 17th army corps to detect the passage of bodies of troops in the neighborhood of forts. From the experiments made, it appears that no difficulty was experienced in distinguishing between the various arms which passed the buried microphone, infantry, cavalry, artillery, and engineers all indicating their personality unmistakably. An attempt was made to count the number of men of each arm of the service, and it is said that out of 5,000 men only 340 were unaccounted for.

Warren Anderson, general manager of the Miami Telephone company of Xenia, O., has printed in pamphlet form his report for the last 18 months, which indicates that the company is doing a prosperous business, and is thoroughly satisfying the demands of the subscribers. The report says: "Your manager is glad to report that the year and a half just closed has been a period of prosperity to the company and of progress generally—in the growth and development of its business, the improvement of its property and the bettering of service afforded to subscribers."

Considerable comment has been indulged in here, says a Washington dispatch, in consequence of the delay attending the decision in the telephone case before Commissioner of Patents Hall. Six months ago application was made by the representative of Inventor McDarragh for a hearing of his claim as the inventor of a telephone operated upon a principle different from that used by the Bell people. The privilege was asked of exhibiting before the commissioner a perfect telephone in demonstration of McDarragh's claim. No disposition has yet been made of the matter.

The following dispatch was sent from Superior, Wis.: The decision rendered in the federal court at Chicago in favor of the Bell Telephone company and enjoining the Cushman Telephone company against the manufacture of instruments and extension of its system, will not have the effect of exterminating the Cushman system from this place. The officials of the company have assurances from their backers in Chicago that their system will not be interfered with. The Cushman has nearly one hundred subscribers here now, while the Bell has but ten, and the city council has ordered it to take out its poles in protection of its franchise to the Cushman company.

The following statement gives the terms on which telephone companies must engage in business in Cuba, Porto Rico, and the Philippine Archipelago: The state is to receive at least 6 per cent. of the gross receipts. The concessions are to last twenty years, at the end of which period everything passes to the state. The telephones, as regards taxes, way-leaves, and hours of service, are to be on the same footing as state departments. The companies who obtain concessions will have to guarantee the service, and erect offices open to the public. The maximum charge for places situated within municipal boundaries is 102 piastres (1 piastre is about 10 cents.) This charge is increased to 204 piastres for flats, and 333 piastres for hotels, clubs, etc. An additional 1½ piastre may be charged for every 100 metres outside the municipal boundaries.

Engineer Raymond, of Washington, D. C., has made a report upon the subject of underground wires to the conference committee on district appropriations. After stating that in compliance with the orders of the commissioners more than five miles of conduits have been constructed by the telephone company, in which 1,356 miles of wire have been buried, constituting more than two-thirds of the trunk lines employed, the report says the system works well, but recent improvements in the manufacture of cables justify the expectation that better results can be obtained. Since the burying of the remaining overhead wires in this service involves extensive excavations in the streets, it is not considered desirable to undertake this until the result of experiments now in progress has been ascertained, especially as the delay will be short. If these results prove satisfactory all the trunk lines overhead should be placed underground as soon as possible. There are about 1,435 miles of such lines. The company intends to put about 200 miles of the wire underground and to bury in addition about 200 miles of new wire. When this work is completed the telephone service will have about 1,756 miles of wire underground trunk lines, and only 450 miles in trunk lines overhead. Electric light wires and those for the telegraph and telephone services should be laid in entirely separate conduits.

THE ELECTRIC MOTOR.

A franchise for an electric railway has been granted at Akron, O.

The directors of the Montgomery, Ala., street railway have not yet decided whether to rebuild the plant for the electric road, which was recently destroyed by fire.

In London, July 7th, Justice Kekewich handed down a decision in which he found that the patent of Gaulard and Gibbs for a new system of distributing electricity was null and void.

The Thomson-Houston company of Chicago will install a tramroad at Nashville, Tenn., for the American Mill company. The road is to be employed for transporting the products of the mill to the warehouse.

The Daft Electric company is to install a plant for the distribution of power at Newark, N. J. The motors, instead of being sold outright, will be rented to the consumers of power at a fixed sum per month, which will include the service of energy required and all necessary repairs. Charles F. Beers will have charge of the business of the company in Newark.

The Sprague Electric Railway and Motor company have closed a contract with the West End Railway company of Boston, Mass. The present equipment will consist of twelve miles of track and twenty cars, and everything is to be as complete in all its details as possible, with ornamental iron poles, etc.

At a meeting of the Brookline Mass., selectmen, July 18th, a petition was received from the West End Street Railway company for leave to erect poles for the operation of its cars by the overhead electric system. The president of the road, Henry M. Whitney, made an address in which he spoke of the advantage of electricity as a motive power and said the running time to Boston could be greatly reduced. He had examined the roads at Richmond and Allegheny City, and was enthusiastic over the results which had been attained. The matter was taken under advisement.

The investigation which has been made of the electric systems now in vogue in Richmond and Allegheny City has disclosed no defects, says the Boston *Journal* in an editorial on electric roads. The tests which the electric railroads in those cities have to bear in the matter of steep grades and sharp curves appear to be beyond anything which would have to be encountered in Boston or its suburbs. It is true that neither in Richmond nor Allegheny City have the electric cars been in operation a considerable time, but the trial would seem to be long enough for all practical purposes. It shows at any rate that what were thought to be insuperable difficulties have been conquered by skill and perseverance, and that if any defect in the electric system remains to be developed it must be a minor one, which would readily yield to the more thorough knowledge of the system which experience with it has afforded.

Personal Paragraphs.

E. Winter of Montgomery, Ala., was in Chicago last week.

C. A. Gates of the Russell Engine company of Macedon, O., was in Chicago last week.

C. E. Scribner of the Western Electric company of Chicago, has returned from his vacation.

E. M. Barton, president of the Western Electric company, Chicago, was in Antwerp, Belgium, last week.

P. C. Ackerman, New York agent of the American Electrical Works of Providence, R. I., was in Chicago last week.

H. B. Thayer, manager of the New York office of the Western Electric company of Chicago, paid a flying visit to Chicago last week.

In his will Hiram Sibley of Rochester, N. Y., left $30,000 to found a professorship in Sibley College of Mechanic Arts at Cornell University.

THE TELEGRAPH.

Cable communication has been opened between New York, Hayti, and San Domingo, via Santiago de Cuba.

Telegrams can now be sent from the United States to Curacoa. It has been suggested that any one failing to find Curacoa on the map would do well to telegraph there direct and ask it to make known its whereabouts.

The following dispatch, dated July 27th, was sent from Omaha, Neb.: "More trouble is threatened from a new feature of the Burlington strike. The management of the road has notified its telegraph operators to leave the Telegraphers' union. This the men refuse to do. One conference has been held between officers of the road and the union, but without result. Another is to be held to-morrow, when it is expected that a settlement will be reached. There is great indignation among labor organizations at what they term the Burlington's resolve to employ only non-union men."

The following appeared in the Pittsburgh *Dispatch:* "A friend of mine in a far western city writes to me that he had a visit from some Indians in the telegraph office in which he works the other day. The telegraphers tried hard to make the Apache brain grasp the extraordinary attributes of the electric fluid, but of course with very little success. The Indians did not enthuse a bit when they were told that some white men living in a town 100 miles away had sent their compliments to the Indian chiefs. They imagined that it was all a fabrication of the deceitful white man. In fact, they would have departed with a poor opinion of the invention of Morse and all the other claimants thereof had not somebody proposed to give them a galvanic shock. This utterly puzzled and at the same time delighted the Indians, who grasped the wire and shouted like schoolboys when the current made them tingle from head to foot."

A dispatch, dated July 25th, from Augusta, Me., says: There was an important hearing before the railroad commissioners at the State House to-day. It was the old fight between the Western Union Telegraph company and the Postal Telegraph Cable company, which is controlled by Mackay. Mattawamkeag is a small place in Penobscot county, where will be the terminus of the Canadian Pacific railroad, now being built across the state, and beyond its trains will be hauled over the European and North American railroad, which is leased by the Maine Central Railroad company, a distance of fifty-six miles, to Vanceboro, which is located on the New Brunswick line. The petitioners asked that the Postal Telegraph company be allowed to erect poles and telegraph wires along this fifty-six miles of road, ostensibly for the purpose of an aid in running trains. It has appeared here, however, that the main object was to build a connecting link, so as to give Mackay a land connection with the Halifax ends of the Commercial cables and New York. The Canadian Pacific Telegraph company and the Postal Cable company are moving hand in hand in the

matter and propose to extend their business into the Eastern provinces which Superintendent Hosmer of Montreal, superintendent of the Canadian Pacific Railroad company, says are controlled by the Western Union company, which is in league with the Great Northwestern company. C. F. Woodard of Bangor appeared for the petitioners to-day and held that their prayers should be granted. They appealed to the railroad commissioners, as by the terms of the contract between the Western Union Telegraph company and the Maine Central Railroad company the latter could not give them that right. Orville D. Baker of Augusta, who appeared in opposition, contended that the petition should not be granted on the ground of public safety, wires and poles being liable to fall and endanger life and property. No decision was reached. It is learned that the Cable company intend to construct a through line from Boston to Halifax via Portland and Bangor at an early day, already being engaged in extending their wires to Portland.

Miscellaneous Notes.

The Helena Montana District Telegraph company has been incorporated, with $30,000 capital stock.

An instrument for registering when a lightning conductor has been struck by lightning has been invented by Messrs. Hoyer & Glahn, of Schonebeck. The instrument consists of a galvanometer, whose magnetized needle is pivoted on a horizontal axis. A soft iron core surrounded by a solenoid, arranged as a shunt between two points of the lightning conductor is placed below the needle. On the core being excited, one of the ends of the magnet is attracted and remains attached, owing to its own permanent magnetism.

In one of the broad windows of the recording department of the office of James Bond, clerk of the Superior court, is a small electric battery, says the Baltimore *Sun*. It is used by the recorders for the relief of the cramp of the muscles of the hand which follows long-continued and steady use of the pen. The relief is instantaneous, and clerks who formerly were compelled at times to stop work for several days on account of swelling and contraction of the muscles of the hand, now take a few gentle shocks of the electric current on the slightest approach of stiffness. They return to work at once, entirely relieved, and continue without inconvenience. Nearly every one of the score of clerks receives benefit from the electric current, and the battery is regarded as an indispensable fixture of the office.

Oscar Ericsson criticises the article of C. K. Giles, on magnetism in watches, and holds that the latter's claim of protection afforded by the anti-magnetic shield is exaggerated. Mr. Ericsson says: "I have experimented considerably with the shield case and every experiment has led to the conclusion that no watch whose escapement, balance wheel or hairspring is made of magnetic metal can be depended on when exposed in the pockets of persons having business around powerful continuous current dynamos. What degree of perfection has been attained in watches made of non-magnetic metal, I am not prepared to state at present. But I have decided to discard the shield and begin observation and experiment with a non-magnetic watch, and if I find my observations sufficiently interesting I shall touch on the subject again."

An ingenious machine is being built at the Ames Manufacturing company's shops at Chicopee under the supervision of the inventor, George A. Goodson, which the inventor claims will revolutionize the present composition of a newspaper, says the *Boston Advertiser*. It is called an electric matrix machine, and intended to do away with newspaper type-setting as practiced at present. All the operator has to look after is the lettering, which is done as on a typewriter, for the machine takes care of the alignment, which is perfect, and, by a novel device for regulating the spacing, the perfect justification of every line is secured. It is estimated that the machine will take the place of four compositors, besides saving the time of distribution. The card comes from the machine a perfect matrix, and all ready for the metal to be cast into it, producing the complete stereotype for the press. The machine is run by electricity.

There being no provision in this country for the accurate comparison of electrical standards and apparatus, it has been decided to provide means for such measurement at John Hopkins University, says *Science*. The work will be under the general direction of Professor Rowland and under the immediate supervision of Dr. Duncan. The comparison will be made by G. A. Liebig, Ph. D., who has been appointed assistant in electricity. The importance of such provision for the comparison of standards has been for some time recognized. Such representative bodies as the American Association for the Advancement of Science, and the National Electrical Conference, held in 1884 at Philadelphia, have discussed the possibility of a bureau of standards, and have favored its establishment. It is not probable that the government will take any steps in the matter, at least for the present, and, as time goes on, the need becomes more pressing. There is needed some laboratory where instruments can be compared with standards of undoubted correctness, by accurate methods and careful observers, under uniform and determinate conditions. These requirements are filled by the standards and apparatus in the possession of the university, and by the facilities and experience that the laboratory offers.

A dispatch from Schenectady, N. Y., last Sunday, says: The foundry connected with the Edison Machine works was destroyed by fire. The loss was $32,000. The building was one of ten which cover five acres of ground. Two men were seriously hurt. One, an employee, was struck on the head by the falling boom of a derrick and his scalp was badly lacerated. The other was caught and bruised between moving cars. One hundred men were employed in the foundry. All the machinery and all the patterns in daily use were destroyed. The cause of the fire is unknown.

The Illinois Phonograph company has been incorporated with headquarters in Chicago. The object of the company is to rent graphophones and phonographs. Harmon Spruance recently of New York, is the head of the movement. Mr. Spruance purchased from the North American Phonograph company of Washington the right to rent instruments in Illinois. The local company will rent its instruments from the North American company and let them to subscribers at an annual rental of $40. A number of business men have already subscribed for instruments, but none can be furnished until October, as they cannot be manufactured rapidly enough to supply the demand. The Chicago company has a capital stock of $1,250,000. The names of Frank A. Wunder and William L. Abbott 42 LaSalle street, and Henry P. Barton, 218 LaSalle street, appear as incorporators.

Business Mention.

H. O. Woodruff, agent of the Sprague company at Des Moines, Iowa, reports orders the past week for a 5-horse power motor from the *Daily Leader* for printing press, a 1-horse power motor from the Des Moines Scale & Wire works for lathe and emery wheels, and for a one-half-horse power from the Des Moines Street Railway company for running horse cleaners.

Chas. A. Schieren & Co. report recent sales of their leather link belting for use on dynamos to the Sandusky Electric Light, Gas, Heat & Fuel company, Sandusky, O., and the Edison Electric Illuminating company, Head Place, Boston, Mass.

Electrical Patents.

Issued July 24, 1888.

386,463. Electric Valve Controller. Emil Grah, Toledo, Ohio.

The invention relates to the control of natural gas. Claim 5 reads: "In combination with a main or supply pipe, a valve located therein, an electro magnet and armature adapted to control the valve, an annunciator, a pressure gauge, and an electric circuit, including the annunciator, gauge, and electro magnet."

386,512. Railway Car. Edmond Verstraete, Chicago, Ill.

386,541. Railway Signal Circuit Breaker. Edward B. Ives.

386,543. Compound Electromotor for Electric Railways. Alfred J. Jarman, London, England.

386,561. Machine for Covering Wire. William H. Sawyer, Providence, R. I.

The invention relates to mechanism for covering electrical conductors with India rubber or other similar material to serve as an insulating and protecting cover.

"Claim 4. In a machine for covering wire, a powder box having a powder and wiping compartment arranged side by side, said powder compartment being provided with a revolving stirrer, for preventing the caking of the powder."

386,569. Porous Cup for Electric Batteries. Bloomfield J. Wheelock and James W. Wheelock, New York, N. Y.

"Claim. The herein-described process of treating porous cups so as to reduce to any desired extent their excess of porosity, which consists in first heating the cups to a degree sufficient to melt wax, then applying to the surface of the cups sufficient wax to reduce their porosity to a limited extent, and repeating these operations as many times as may be necessary to bring the cups to the desired degree of porosity."

386,580. Storage Battery. John A Enos, Boston, assignor to William C. Otis, Nahant, E. Herbert Ingalls and Paul West, Brookline, and William E. Plummer, Newton, Mass.

386,581. Current Receiver for Electric Railway Cars. John A. Enos, Boston, assignor to William C. Otis, Nahant, E. Herbert Ingalls and Paul West, Brookline, and William E. Plummer, Newton, Mass.

386,597. Electrical Call System. James C. McLaughlin, Kansas City, Mo.

"Claim 1. In an electrical annunciator, the combination of the call drops, a movable actuating bar to return said drops to their normal position, and registers disconnected from said drops and actuating bar, but arranged in the path of said drops, so as to be thrown from their normal position as the drops fall."

386,602. Electric Governor. Horace W. Parsons and John Hoduit, Wamego, Kan.

386,636. Latch Opener for Knitting Machines. Lewis Jones, Jr., Overbrook, Pa.

386,646. Electrical Type-writer. James F. McLaughlin, Philadelphia, Pa.

"Claim 7. The combination, with a series of insulated current conducting segments charged from a suitable source of electricity, of a moving arm provided with a spiral spring contact electrically in circuit with said series of segments."

386,648. Inductometer. George Miot, Paris, France.

The last claim as follows: "3. An inductometer comprising the U-shaped tube, the capillary tube, and the bulbs, the lower portion of said tubes being connected with the upper part thereof by flexible coupling tubes."

386,685. Dynamo and Motor. Charles E. L. Brown, Zurich, Switzerland.

386,729. Telegraph Key. Louis Townsend and John E. Auten, Evansville, Ind.

"Claim 1. The combination of the bifurcated key lever, the base-posts, and the spring bearing with its free end against the bifurcated end of the lever."

386,754. Electro-Medical Apparatus. John S. Muir, San Francisco, Cal.

386,767. Watchman's Electric Time Recorder. George F. Bulen, Brooklyn, N. Y.

386,772. Electric Signal or Alarm. Edward Davis, Cambridge, Mass.

The invention relates to police signal boxes. The tenth claim is as follows:

"In a signaling apparatus, the combination with the circuit varying contacts arranged to transmit a predetermined signal, and a motor, with one or more teeth or projections arranged to operate upon the contacts to cause them to vary the signal from the normal when projected, a catch for holding said teeth projected and a projection operated by the motor for releasing said catch when the signal has been sent, and a removable key for projecting one or more of the teeth, and thus varying the signal in accordance with the particular key employed."

386,775. Dynamo-Electric Machine. Waldemar Fritsche, Berlin, Germany.

"Claim 6. The combination, with an armature having a series of peripheral contacts, of a plurality of current collectors, each comprising two revolable contacts, one in contact with the armature and the other with a conductive fluid, and a conductive connection between the two."

386,784. Overhead Wire Connection for Electric Railways. Walter H. Knight, New York, N. Y.

The invention consists in a device for maintaining connnection between an electrically propelled car and an overhead supply wire.

10,949. Coin-Operated Induction Coil. Percy G. Williams and Alfred W. Roovers, Brooklyn, N. Y.

This invention relates to machines in which a coin of a certain weight is employed to cause the machine to operate. We give the first claim:

"The combination, with a case, of an induction coil, an electric battery for energizing the same, contact pieces, a normally open electric circuit comprising the primary of the induction coil, the battery, and said contact pieces, a rocking lever adapted to be rocked into contact with said contact pieces and close the said circuit upon a coin of desired weight and size lodging upon said lever until said coin is removed, a longitudinally movable part in electrical contact with the secondary of the induction coil, and two electrodes outside the case, one of said electrodes being longitudinally movable and rigidly connected with said longitudinally movable part."

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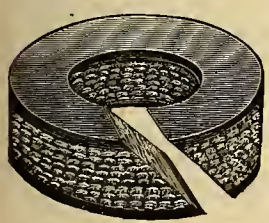

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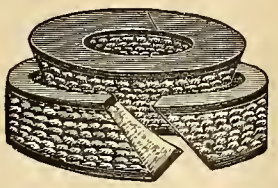

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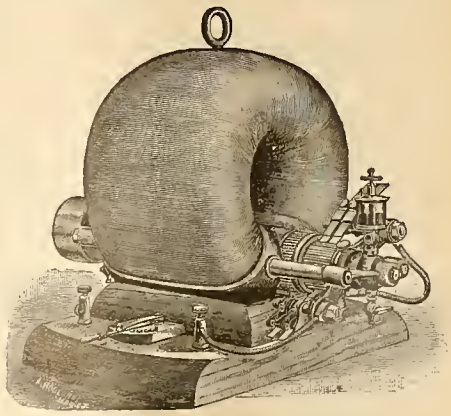

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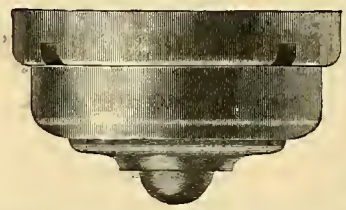

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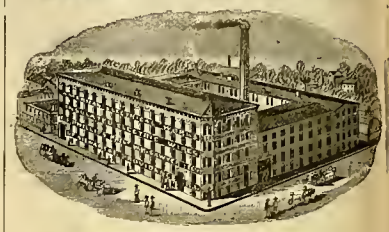

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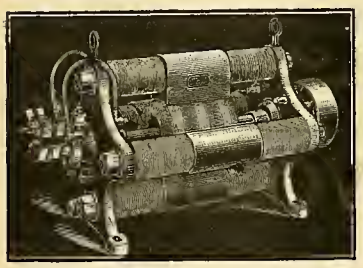

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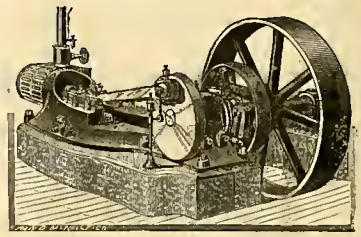

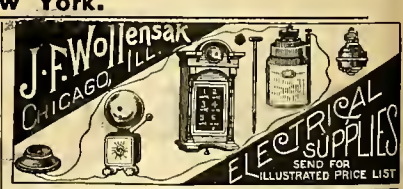

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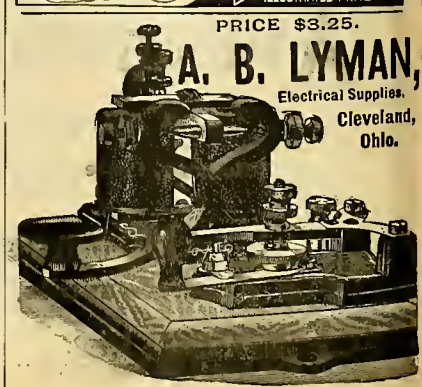

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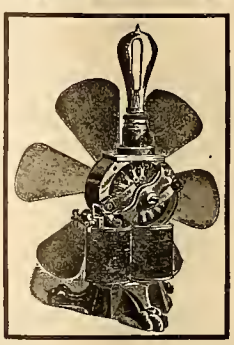

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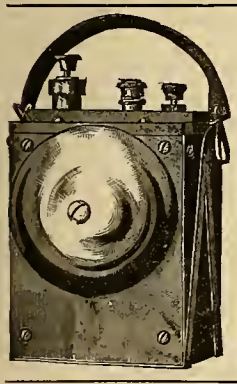

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Sure protection from all Electrical and Magnetic disturbances. Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

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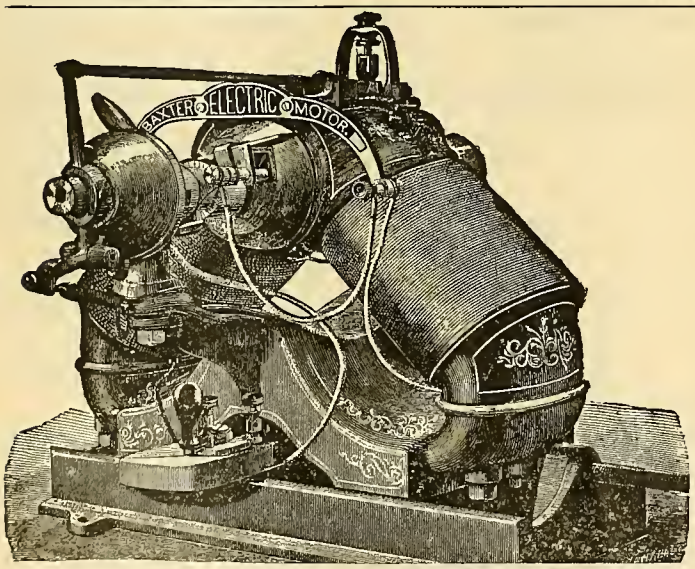

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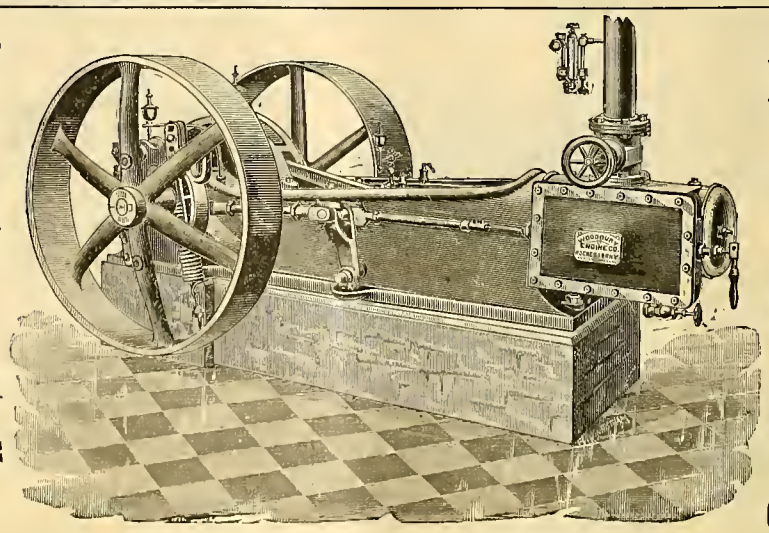

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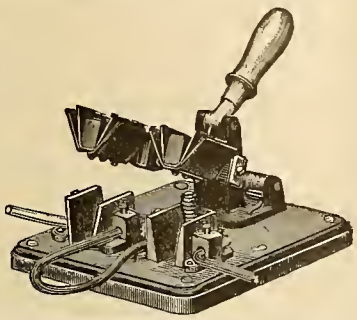

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Lamps fitted to any Lamp Cap that may be supplied.

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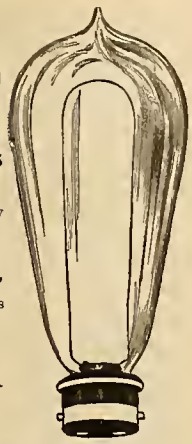

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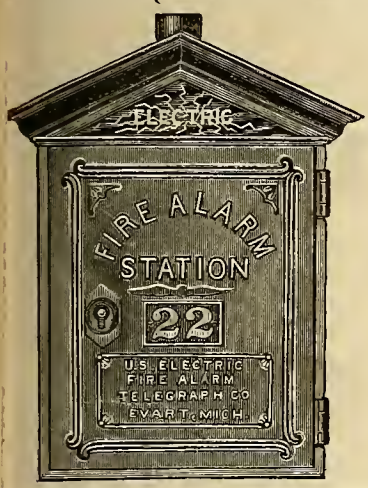

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Do write an order.
Do send it to us.
Do read our catalogue No. 547.
Do note that it contains all information concerning wires, cables, conductor cords, metals, etc.
Do, Do, Do read page 9 very carefully.

Do read catalogue 548.
Do remember that it is illustrated.
Do come to the conclusion that you find illustrated in it what you long have wanted, but did not know where to procure, or how to describe.
Do put on your spectacles when reading page 53.

Do just look at our catalogue No. 549—it illustrates all tools needed by Electric Light men.

Do let us have your opinion about catalogue No. 645—Electrical Home Goods, such as Bells, etc.

REMEMBER

P. and B. waterproof and weatherproof line wire is the best and cheapest substitute for "Undertakers."

What page 41, catalogue 548, looks like.

What pages 52 and 53, catalogue 548, say.

What the WESTERN ELECTRICIAN of July 28 said about Kerite wire and tape.

What page 9, catalogue 547, says.

That you can find any tool you want illustrated in catalogue 549.

That our catalogues contain practical information for Superintendents.

That our catalogues contain practical information for Linemen.

That you should notify us promptly if catalogues asked for do not arrive.

US.

We do not often see ourselves in print and put that word up there to see how it would look.

The following circular is intended for our customers to whom it refers—those who find it does not refer to them will please not read it:

TO OUR CUSTOMERS.

We would remind you that during the past week we have made many quotations—quotations on wire—quotations on construction material—quotations on tools—quotations on bells, annunciators, etc—quotations on goods we never heard of—goods which we believe were never yet made—which we do not think can be made—yet we quoted for them as you requested us to do so. Our inquiries concerning some of these quotations remain unanswered, and, as a consequence, our sleep is disturbed, our rest broken, our duties as husbands, fathers, wives and citizens neglected—we no longer take any interest in base ball (wish Anson was leading again), or the presidential election—even an aldermanic election in our own ward would fail to interest us—and you are responsible.

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AND

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Consult our catalogues and make us a proposition. You may seal by licking the "gum stickum."

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All kinds—see our catalogues for particulars.

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Poke the man who says P. and B. waterproof and weatherproof line wire is not the best—stir him up a little and see what he is made of—then look into him and you will find he is talking to further his own interests, not yours.

THE "CHICAGO TRIBUNE" SAYS:

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We should think that Friend Anson would know that a base ball club should use only the Diamond Battery—There is "NO POOR BATTERY WORK" when the Diamond Carbon Battery is used.

BLUE VITRIOL.

We are headquarters. Write for samples and quotations.

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Use Kerite Tape in order to make sure of secure joints.

DISTRICT TELEGRAPH COMPANIES

Can secure all material and supplies from us at bottom prices.

ELECTRIC LIGHT COMPANIES.

Please remember that we furnish everything required for the construction or operation of Electric Light lines—we furnished several new companies with complete outfits, including poles, during the past two weeks. See our catalogues before starting to build—everything illustrated.

DYNAMO TENDERS' HAND BOOK.

If you are running a plant you cannot afford to be without this work—Price one dollar.

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For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

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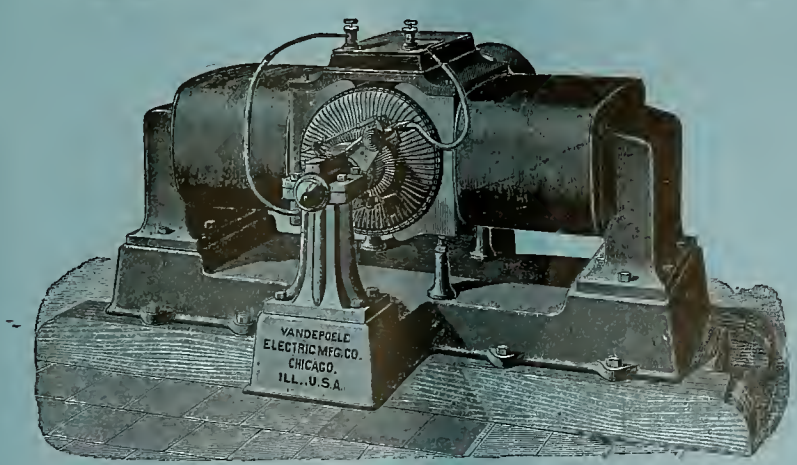
Double Carbon Lamp.



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Single Carbon Lamp.

MUNICIPAL LIGHTING Our SPECIALTY.

☛ We claim for the Van Depoele Improved Arc Lamp that it is the simplest and best lamp in existence; for our Dynamos that they cannot get out of order, and require little or no attention; that an inexperienced man can run them, and that they give the most light for the least consumption of power.

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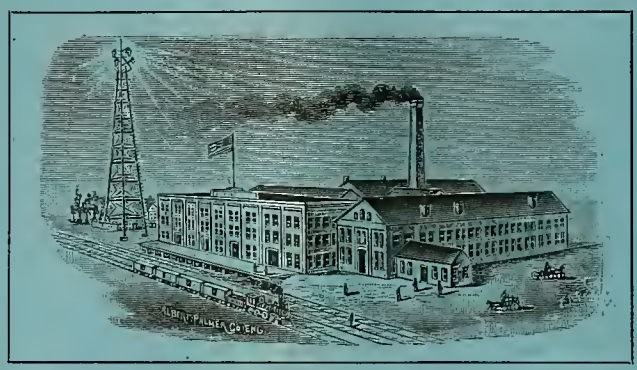

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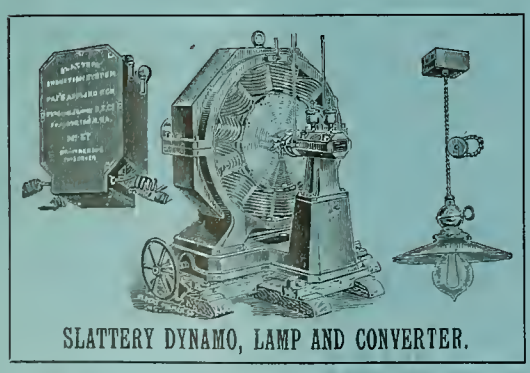

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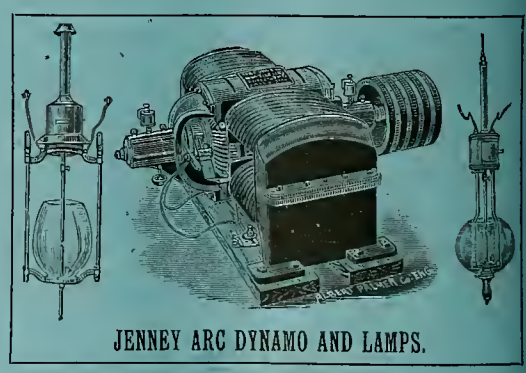

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Western Electrician.

3 per Annum. EVERY SATURDAY. 10 cents per Copy.

ol. III. CHICAGO, AUGUST 11, 1888. No. 6

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MANUFACTURERS OF

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For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial.

LIGHT LEADED CABLES FOR HOUSE USE.

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Five Years of Uniform Success Enable us to Guarantee our Cables.

DAY'S KERITE INSULATION.

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

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All Sizes *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

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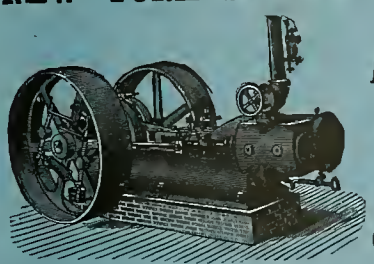

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And other duty requiring close regulation of speed.

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A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

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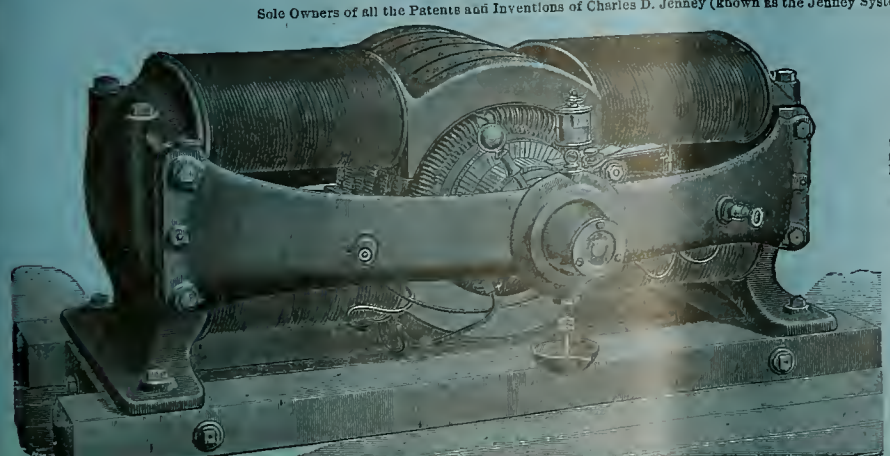
Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

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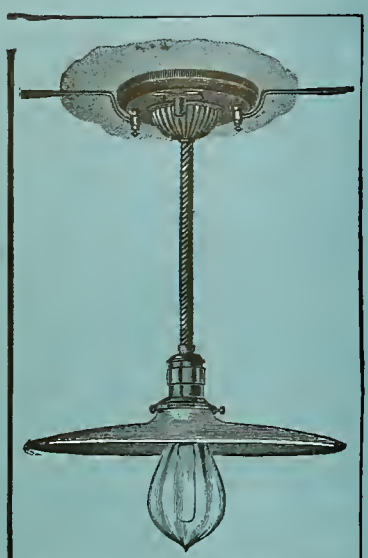

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These Lamps have repeatedly shown their superiority under test.

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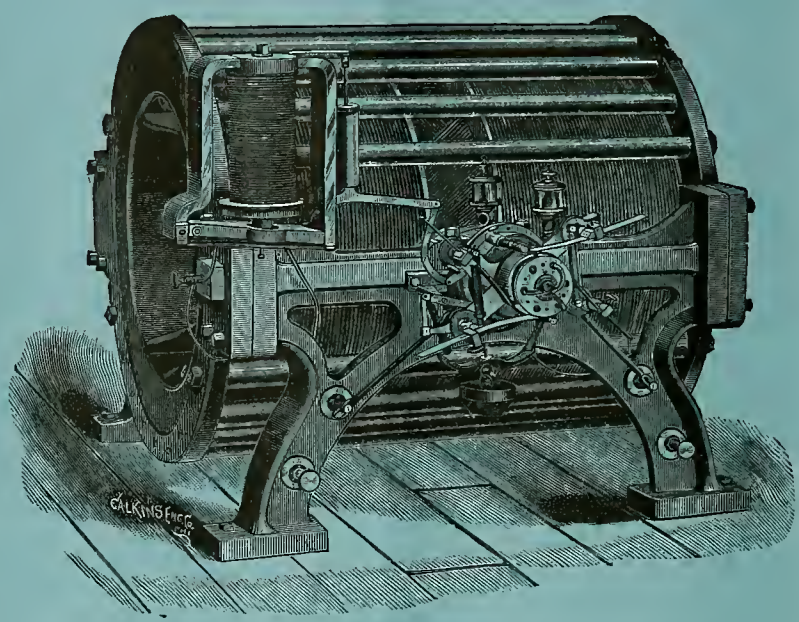

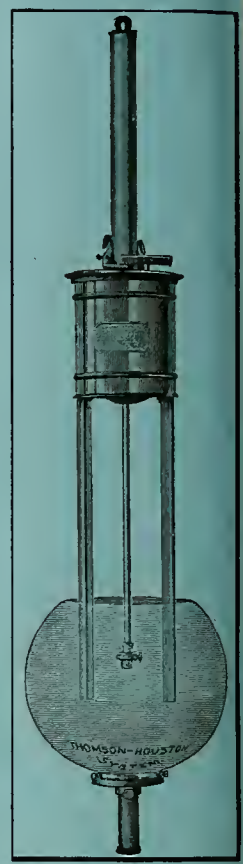

This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

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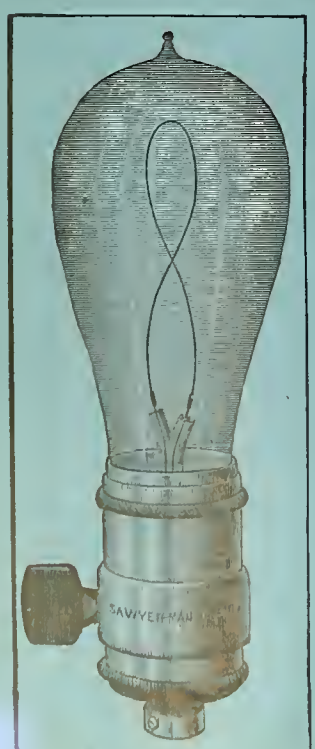
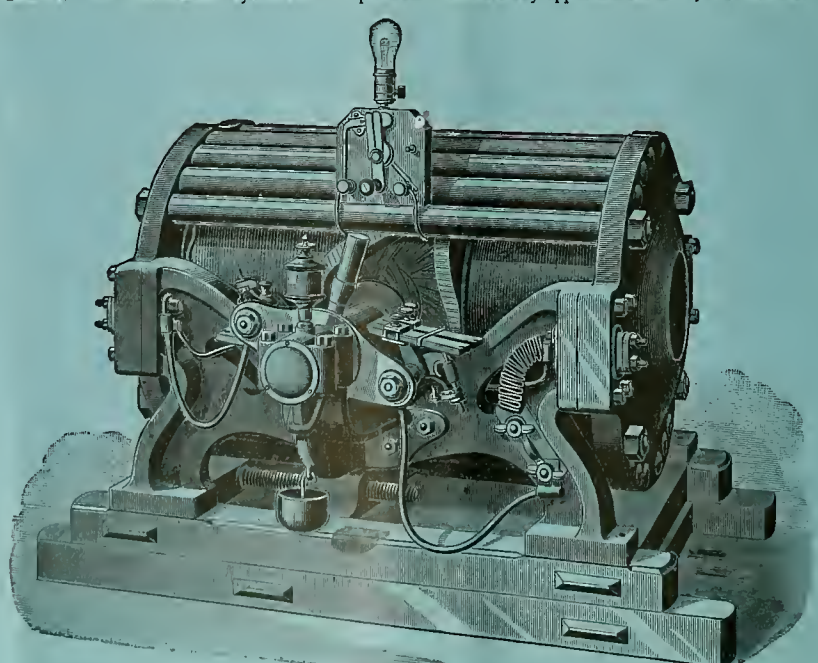
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

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Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

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THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

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As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
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BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

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Edison Electric Light Co.,
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U. S. LAMP.

GRAND OPERA HOUSE

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610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

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Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

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Especially Adapted to
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Isolated Lighting, Railroad Car Lighting,
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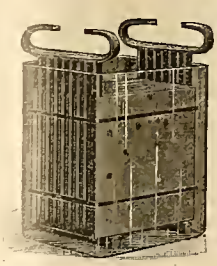

Among the Advantages of this System are:

Absolute Certainty of Light,
Increased Life of Lamps,
Great Economy of Running Expenses,
Absolute Steadiness of Current,
Utilization of Surplus Power,
Adaptability to Existing Plants,
And Complete Displacement of Gas.

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Richmond Extension	50 "	Salem, Mass	6 "
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Wilkesbarre, Pa	4 "	Hartford, Conn	2 "
St. Joseph, Mo	8 "	Scranton, Pa	20 "
Wilmington, Del	3 "	Steubenville, Ohio	6 "
Harrisburgh, Pa	6 "	Manchester, Va	10 "
Lafayette, Ind	9 "	Akron, Ohio	12 "

February 1st not a Road in Commercial Operation, To-day Consult the Above Record.

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For Light and Power Purposes.

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Factory, Corner 13th and Woodbridge Sts.

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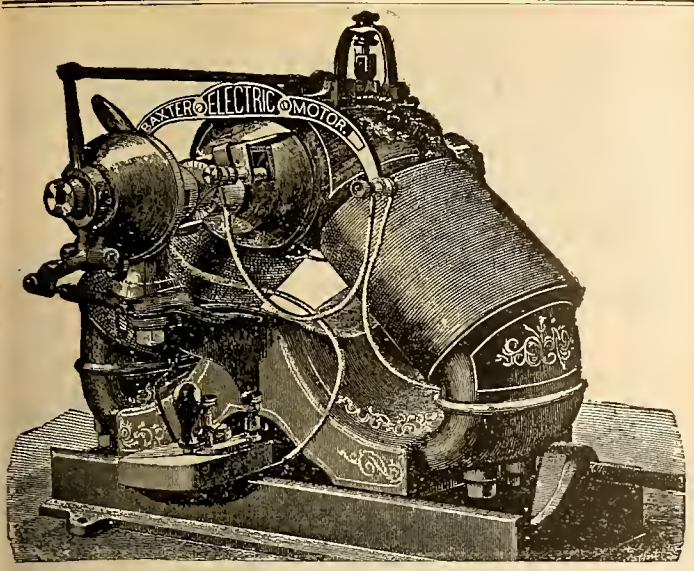

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This Motor is now ready to be placed upon the Market.
Manufactured for both

Arc and Incandescent Circuits,

THE ONLY PERFECTLY GOVERNED MOTOR EVER MADE.

CORRESPONDENCE SOLICITED.

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BOSTON:
Rooms 57 & 58 Hancock Bldg., 178 Devonshire St.

Western Department, Dearborn Building, 130 Dearborn St., Rooms 30-31, Chicago, Ill.

J. J. DICKEY, President. ISRAEL LOVETT, FLEMON DRAKE, Vice President.
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→*AMERICAN + DISTRICT + TELEGRAPH + SYSTEM,*←

and are prepared to give franchises and construct plants on reasonable terms.

☞ Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

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15 DEY STREET,

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Manufacturers and Dealers

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ELECTRICAL SUPPLIES.

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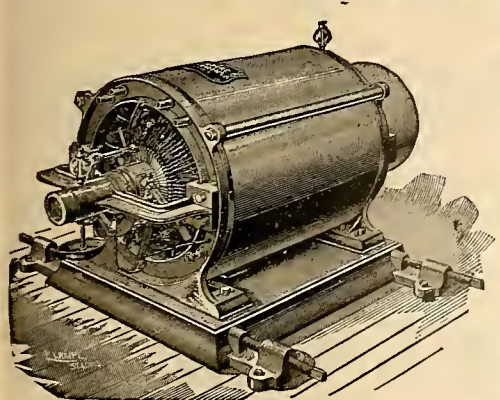
MANUFACTURERS OF

The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

High Insulation

In order to meet the constantly increasing demands for

BETTER INSULATION,

THE BISHOP GUTTA-PERCHA CO.

420-426 EAST 25th STREET, NEW YORK CITY,

HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

FOR MAKING THE CELEBRATED

HOOPER'S CORE

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FOR INSULATING WIRES FOR

Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading-in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

HENRY A. REED, Manager.

Use Marks' Compound Wire for Battery Coppers.

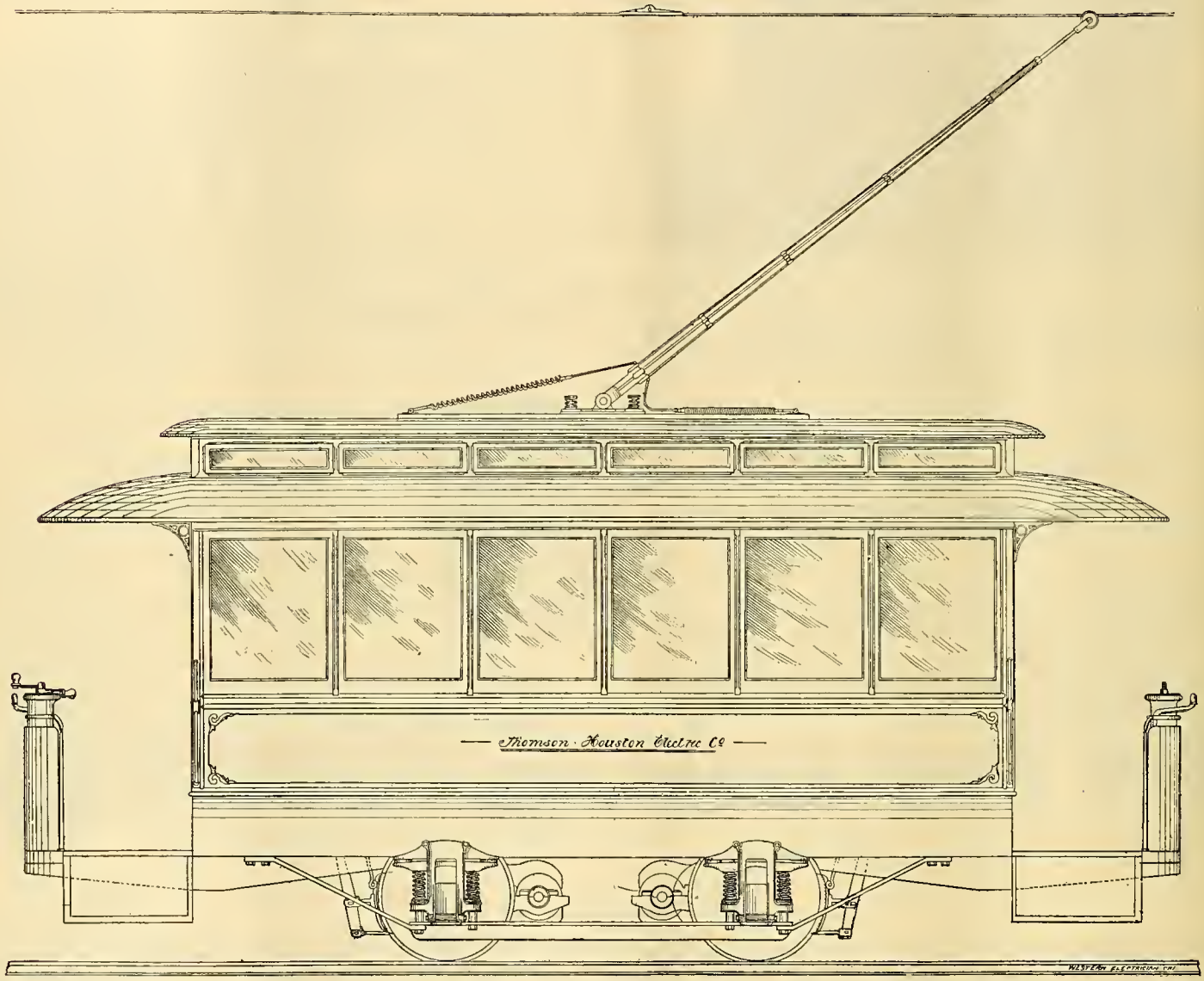
Use Balata Insulation for Flexible Cords.

USE NOTHING BUT

GUTTA-PERCHA FOR SUBMARINE CABLES.

The Thomson-Houston Electric Railway System.

THE THOMSON-HOUSTON ELECTRIC COMPANY HAS RECENTLY PURCHASED ALL THE VAN DEPOELE ELECTRIC RAILWAY PATENTS.



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ALL MATERIAL IS NOW MANUFACTURED AT THE **FACTORY** *AT* **LYNN,** *MASS., THE LARGEST AND BEST EQUIPPED ELECTRIC FACTORY IN THE WORLD.*

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Van Depoele patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

MOTORS & ELECTRICAL EQUIPMENTS FURNISHED FOR MINING & OTHER SPECIAL WORK.

For Full Information and Estimates Address the

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THE

WESTINGHOUSE ELECTRIC COMPANY,

PITTSBURGH, PA.,

Manufacturers under Patents controlling the Sale and Use

OF

ALTERNATING CURRENT ELECTRIC LIGHTING APPARATUS.

The installment of over 100 Central Station Plants has demonstrated the Alternating Transformer System to be superior to all others, for distributing current from a Central Station over small or large areas for lighting and power purposes.

ALTERNATING CURRENT METERS.

This system is made more profitable than any other by the use of the meter now supplied by this company.

It measures the whole current.

It is strictly a positive mechanical movement.

It registers directly in lamp hours.

It reads from dials like a gas meter.

It consumes no appreciable energy.

It is not affected by temperature or other local conditions.

It is practical, and it is cheap.

ALTERNATING CURRENT MOTORS.

This company has demonstrated that motors run by the alternating current are as efficient as the best direct current motors, and can be run without commutators or brushes, being started, stopped and reversed without breaking a connection.

All parties desiring to secure the most perfect system of electric distribution for light and power are invited to inspect the apparatus at the works of the company at Pittsburgh, Pa., where it will be demonstrated that the Alternating System possesses such advantages over the direct system in regard to efficiency, distribution, safety, life of lamps, and the use of meters and motors, that no purchaser can afford, at any price, to take the direct current apparatus.

WESTERN ELECTRIC CO.

CHICAGO. NEW YORK. LONDON. ANTWERP

Electric Arc Lighting Apparatus.

Electric Bells, Annunciators, Etc.

Patterson Cables for Telephone, Telegraph and Electric Light Use.

Insulated Wires of all Kinds.

Testing Apparatus.

District Telegraph Police and Fire Alarm Apparatus.

Telegraph Apparatus.

Construction Tools.

Line Wire and Supplies.

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THE BEST OF EVERYTHING AT BOTTOM PRICES.

Catalogues Furnished on Application.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, AUGUST 11, 1888. No. 6.

The Sperry Double Induction Motor.

Electric motors of large sizes have been made with high efficiency, but heretofore small electric motors have proved unsatisfactory, because their efficiency runs down to a point where the cost of maintenance has precluded the possibility of their use with any degree of economy. The fact that they require frequent repairs has prevented continuous use. These objections have prevented their general introduction, still the demand for a good working electric motor has been so great that sometime ago the troubles developed during the years of experience were collected and carefully studied, and the Sperry double induction motor has been produced, which is free from the faults of many previously introduced. This motor has been subjected continually to the most rigid tests and has withstood them perfectly, and can be fully recommended where small power is required. The motors are manufactured with fittings for special attachments, and may be operated in connection with any source of electricity; from a battery—a special form of which is constructed and furnished—and from arc or incandescent circuits of any system.

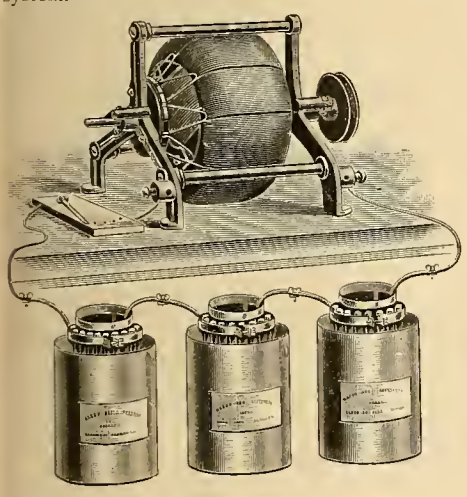

FIG. 1.—SPERRY DOUBLE INDUCTION MOTOR.

An automatic cut-out is provided for arc circuits. The points of superiority claimed are its remarkably high efficiency considering its size. The armature or the revolving part never changes its polarity, even when running 1,000 revolutions per minute—a fact which is not true of any other motor. This does away with the great amount of energy required to magnetize, demagnetize, and then magnetize up of opposite polarity. This loss is continually going on in an ordinary motor armature, but in this motor it is utilized in effective work.

The revolving wire coil is surrounded on every side by the iron of the magnetic circuit, similar to the modern practice in the manufacture of alternating current converters. This doubles the inductive effect of the coil and is the principal feature in the increased high efficiency of the motor. This is illustrated in Fig. 2, in which the lines of magnetic force are shown by the arrows in a practically closed circuit, and the section of the coil itself is shown by the small circles.

The motor is perfectly non-magnetic; the value of this feature can hardly be over-estimated. It will not magnetize or affect the most sensitive watch yet made. On the contrary, it will take out any magnetism there may be in it. Watches are continually affected by electric motors and their accurate timing qualities ruined, in many instances when the owner least suspects the cause. This motor is guaranteed against the magnetization of any watch ever made.

There is no many-parted commutator of delicate construction in this motor or a many-coiled armature which revolves or moves, and is therefore liable to get out of order. A single coil which never changes its polarity or circuit connections is the only revolving and driving element, and it cannot get out of order. The motor always runs in the same direction, no matter how it is connected; therefore there can be no mistake about the direction of rotation. This motor is constructed in a thoroughly workmanlike manner, and only first-class materials are employed. The spindle is of the best steel and all parts are solid and durable, at the same time neat and ornamental in appearance.

The special features which recommend the Sperry battery for this and other work are as follows: The element of internal resistance in estimating the current generated by a given combination of materials has generally been ignored, but it is an extremely important feature. The porous cup in the cell ordinarily adds considerably to the internal resistance, it being of insulating substance; but a new fluid has been found which, added to the electrolyte within the cup, reduces the internal resistance to a minimum, the principle upon which it acts is, it permeates more perfectly the porous materials. A heavier current and one capable of doing more work is said to be produced in this cell than from any cell previously constructed of the same size. It gives forth no fumes and no salts collect; it can be used either on an open or closed circuit. The zinc efficiency of this new cell is 95 per cent. The expense for chemicals and time required by the battery for a given amount of work are very small. These cells do not polarize and may be used continuously until the chemicals are exhausted, a feature which will commend itself to all who have had experience with ordinary batteries.

A special form is made for surgical and dental purposes. The apparatus is manufactured by Elmer A. Sperry company, and sold by the Electrical Supply company of Chicago.

Incandescent Lamps at the Cincinnati Exposition

Incandescent lamps form an essential part of the decorations at the Cincinnati Centennial exposition. In the floral hall the waterfall makes a fine display. There are twelve bridges from which project twenty-eight lights. In the basin of the fountain are lamps with colored globes placed above reflectors. The effect is brilliant although Cincinnati water is not the best medium for the passage of light; six vases filled with flowers and lighted by lamps form another attractive feature. Suspended above the floor is a flower-pot lighted by an incandescent lamp. The flowers are continually sprayed by a tiny fountain. The water is kept flowing by means of a small motor. Arranged among the flowers about the hall are concealed lights which add a brilliant effect to the display.

Surrounding the fountain in the Park building are nine arches, each bearing thirty-six lamps with different colored globes. On the ring above the fountain, where the arches are joined, are six 32 candle power lamps with cut glass globes. There are several "umbrella" fixtures with lamps in different parts of the hall. A rotary table bearing plants, among which lights are concealed, is another brilliant decorative feature.

William J. Hammer, the electrical expert in charge of the Edison lights, is preparing a novel exhibit. It is a mammoth Edison electrical globe composed of 15,000 of the regular electrical globes. This exhibit will be nearly thirty feet high. It will glow as one colossal lamp of 100,000 candle power. It stands on a base of about 3,200 globes that will gleam pure white, except where word "Edison" will flash and glow in colored effects.

There is the immense socket three feet high upholding the great globe inclosing the myriad smaller ones. From this great globe, which resembles a balloon, will come a soft radiance of colored lights.

At the front just over the base, in tablet form, is a shield which will gleam in red, white and blue stripes and the stars in blue field. On this shield will be the inscription in infinitesimally small globes of lettering, "Exhibit of Edison Lamp company, Harrison, N. J.," employing nearly 15,000 Edison lamps and illustrating the capacity for manufacture of the factory per twenty-four hours.

Largest Telephone Exchange.

A correspondent writes as follows in reference to Mr. Lockwood's statement in the last issue of the WESTERN ELECTRICIAN, that only one exchange in the world had as many as 7,000 tele-

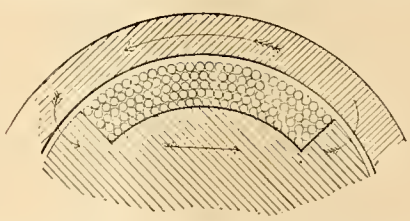

FIG. 2.—SPERRY DOUBLE INDUCTION MOTOR.

phone subscribers, and that exchange was in New York: "One pauses before contradicting Mr. Lockwood or differing with him in any way on subjects telephonic, he is generally so accurate and always so well informed; but for once it seems Homer is caught nodding. There is trustworthy information to the effect that there are 10,000 subscribers in the Berlin exchange, which is operated by the German government. New York, it is true, has the largest number of lines concentrating in one central office—the Courtlandt street Exchange. But even that does not number 7,000. This oversight of Mr. Lockwood's does not interfere at all with the force of his criticism. In that he is, as usual, exactly right."

Chicago Electric Club.

The Chicago Electric club committee on new quarters met at the club rooms on the evening of August 1st. There were present S. A. Barton, chairman; C. D. Shain, C. A. Brown, and B. E. Sunny. Various plans and localities were discussed, and Messrs. Sunny and Leonard were appointed a sub-committee to investigate quarters adjacent to the University club. The committee will meet again after President Barton's return from the east.

The long distance telephone will be in working order to Buffalo, a distance of over 500 miles, in a few weeks. This will be the longest telephone circuit in the world, and much speculation is made as to whether or not the scheme will prove successful. If the results fully meet the expectations, Chicago will soon be connected with New York by public telephone exchange.

Gray's Telautograph.

Among the patents issued July 31st is one relating to Professor Elisha Gray's telautograph. Much has been written of this new instrument, and, as public curiosity has been aroused in regard to it, we reproduce from the patent specification the cuts showing the details in their entirety, and an exhaustive abstract of the descriptive matter.

The invention relates to a writing telegraph of that class in which the act of writing the message at the transmitting station operates to reproduce it at the receiving station. After rehearsing the various difficulties inherent in other systems of telegraphy of this class, the specification continues:

The system consists, primarily, of two instruments, a transmitting instrument, and a receiving instrument, herein termed "transmitter" and "receiver." The transmitter and receiver are provided with transmitting and receiving pens, which can be moved over fields of considerable extent. If the system is designed for transmitting messages in writing, the fields will be equal in one direction to the length of a line of writing and in the other direction to the distance above and below the line occupied by any

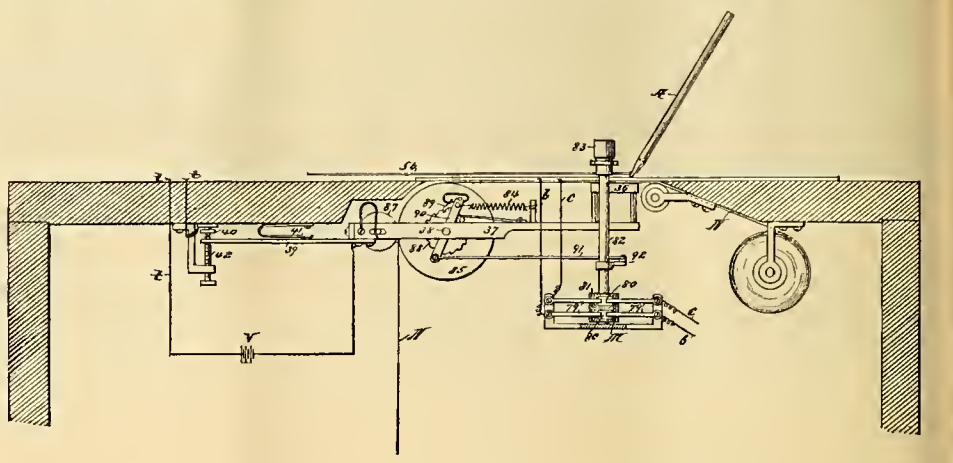

FIG. 2.

ing pen, and thus reproduce the matter written or traced by the operator.

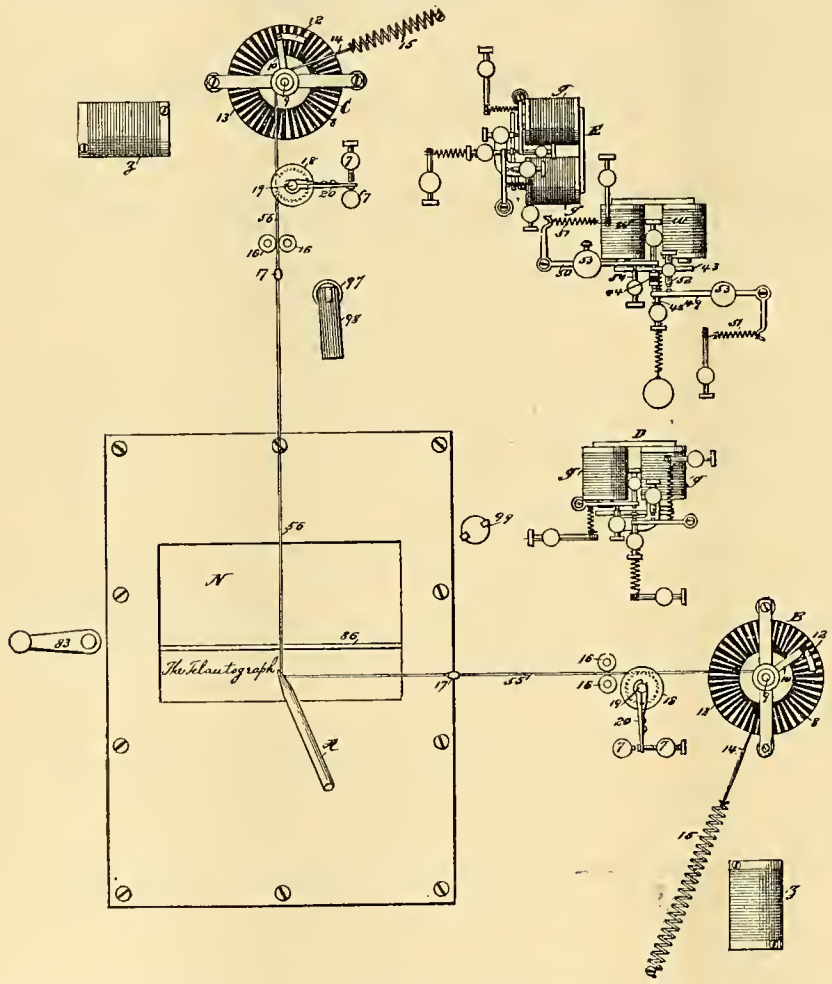

FIG. 1.

character. The transmitting pen is connected to operate circuit making and breaking devices, termed "interrupters," located in two electric circuits and arranged to interrupt the currents passing over the respective circuits at short intervals, producing pulsations therein as the pen is moved in two directions crosswise of each other in forming characters, the number of pulsations in the respective circuits being determined by the distance which the pen is moved in the respective directions. These two circuits pass through the receiver and include electro motors, also hereinafter termed "receiving magnets," the armatures of which act through suitable connections to impart a step-by-step movement to the receiving pen in two directions crosswise of each other, the number of steps in each direction being determined by the number of times the respective circuits are interrupted. By this means the movements of the transmitting pen in the two directions operate through the interruptions in the currents passing over the circuits to impart corresponding movements to the receiving pen, and thus reproduce the matter written or traced by the operator.

Cooperating with the receiver or forming a part thereof is a means for supporting a recording surface, upon which the message is reproduced. This recording surface, which will usually be paper, and will therefore be herein termed "paper," may be either in the form of a continuous ribbon or strip or in the form of a pad or a detached sheet. The receiver is also provided with means, which is under the control of the operator at the transmitter, for shifting the paper after the completion of each line of writing, so as to bring it in proper position to receive the next line, and so on. In the preferred organization of the system the paper is stationary during the writing and is shifted after the completion of each line; but this may be reversed, the pen being stationary and the necessary movements to form the characters being imparted to the paper; or the movement in one direction may be imparted to the paper and in the other direction to the pen. In any case, however, the paper is not fed continuously and independently of the control of the operator during the writing, but is only moved in conformity to the movements of the transmitting pen. From this it results that the reproduction is in the handwriting of the operator, and that the operator can pause at any point and for any length of time, and upon recommencing the writing the receiving pen will continue the record from the point where it was interrupted, and also that the operator can go back in the line and make a correction, addition, or erasure at any point. The operator is also permitted to write at irregular speeds and is relieved from the necessity of distorting his writing.

The system is provided with connections by which, whenever the transmitting pen is raised slightly, the same as in raising a pen or pencil from the paper in ordinary writing, the receiving pen is correspondingly raised, and vice versa. By this means, when the end of a line is reached and the transmitting pen is moved back to commence a new line, or when it is necessary to go back in the line to make a change, or when it is desired to disconnect letters or words, it is only necessary to raise the transmitting pen in the ordinary way in order to prevent the receiving pen from making a continuous mark, and thus marring the record.

Figure 1 is a plan view of the transmitter. Fig. 2 is a vertical section of the same, taken on the line 2 of Fig. 1. Fig. 3 is an enlarged plan view ofone of the interrupters and the two parts immediately connected therewith. Fig. 4 is a sectional elevation of the same. Fig. 5 is an enlarged plan view of one of the pole changers. Fig. 6 is an elevation of the same. Fig. 7 is an enlarged plan view of a pair of reversely arranged temporary circuit breakers, the purpose of which willbe hereinafter explained. Fig. 8 is an elevationof the same. Fig. 9 is an enlarged plan view of a pen rack for receiving and transmitting pen when it is not in use, showing also a switch mechanism for connecting the receiver or transmitter at any station with the line wires. Fig. 10 is an elevation of the same. Fig. 11 is a plan view of the receiver. Fig. 12 is an enlarged plan view of one pair of the receiving magnets. Fig. 13 is an end elevation of the same. Fig. 14 is a side elevation of the same. Fig. 15 is a vertical

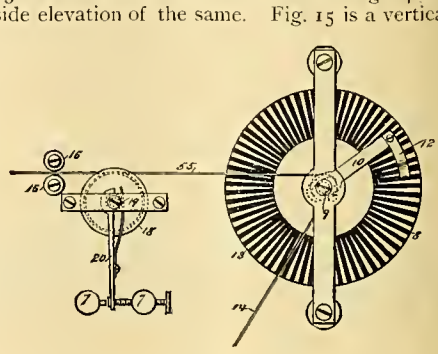

FIG. 3.

section taken on the line 15 of Fig. 11. Fig. 16 is an enlarged plan view of one of the polarized relays. Fig. 17 is an end view of the same, with certain parts removed. Fig. 18 is a diagram showing the electrical connections through

which the system is operated. Figs. 19, 20 and 21 are views illustrating a modified arrangement of the receiving magnets, Fig. 19 being a side elevation, Fig. 20 an end elevation, and Fig. 21 a plan view. Figs. 22, 23, and 24 are views il-

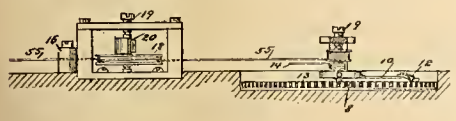

FIG. 4.

lustrating a means of imparting a movement to the paper corresponding to the movements imparted to the receiving pen in the system, as illustrated in the other figures, Fig. 22 being a plan view, Fig. 23 a section taken on the line 23 of Fig. 22, and Fig. 24 a section taken on the line

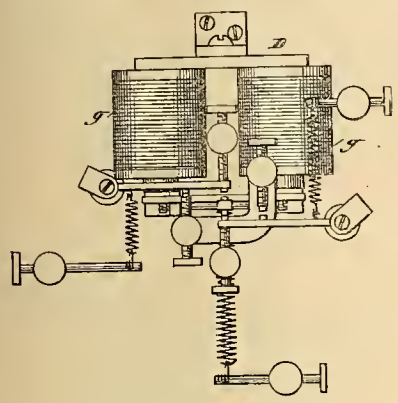

FIG. 5.

24 of the same figure. Fig. 25 is a view indicating a modification of the form of recording surface shown in Fig. 11, and Fig. 26 is a modification of the receiving pen.

Referring to Figs. 1 to 10 and 18 the pen A is connected at its point to two

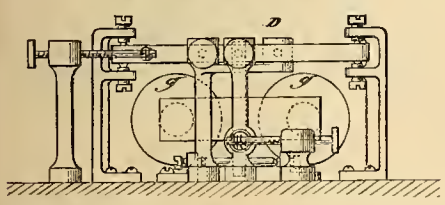

FIG. 6.

cords or other flexible connections, 55, 56, which extend horizontally crosswise to each other, and are connected to and operate the two circuit making and breaking devices B C, termed "interrupters," located in two electric circuits, *b*, *c*, termed "main circuits," and so arranged that as the pen A is moved from left to right and

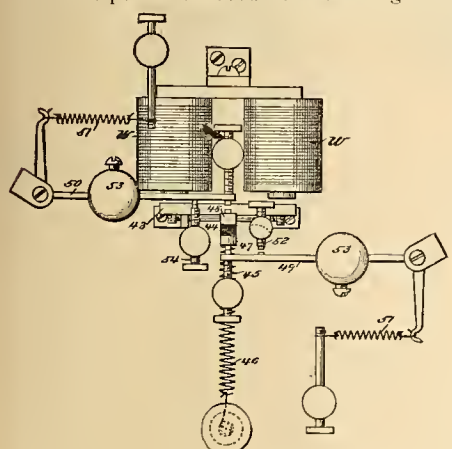

FIG. 7.

vice versa the circuit *b* is interrupted or made and broken repeatedly in quick succession, producing pulsations therein varying in number with the linear extent of the movement of the pen A and varying in speed of succession with the rapidity of such movement, while as the pen is moved up and down in forming the characters the circuit *c* is interrupted and the pulsations produced therein in the same manner.

The two interrupters B C and their auxiliaries are exact duplicates. Each of the cords 55, 56 is connected to and wound upon a small drum. Figs. 1, 3, and 4, upon a shaft 9, to which one wire of the circuit is connected. The shaft 9 is provided with an arm, 10, the end of which carries a brush, 12, which sweeps in contact with the

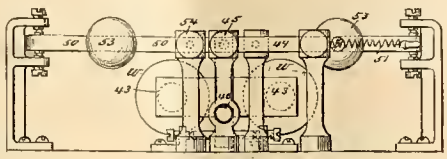

FIG. 8.

face of a metallic disk, 13, to which the other wire of the circuit is connected. The face of the disk over which the brush 12 sweeps is provided with a series of channels or cuts located in close proximity and containing pieces of insulating material, 8, so that as the brush sweeps over the face of the disk in either direction the current passing over the circuit in which the brush and disk are located will be interrupted or made and broken

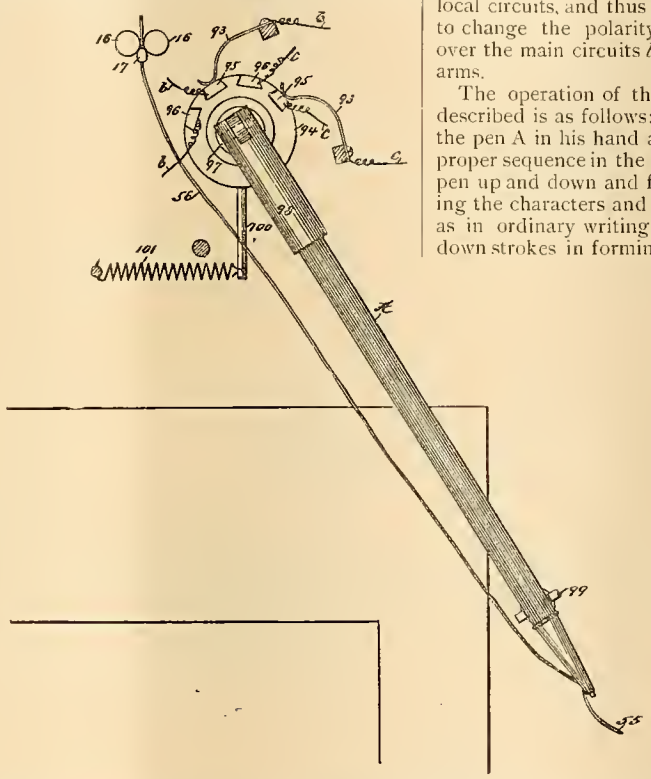

FIG. 9.

repeatedly in quick succession, the number and rapidity of the interruptions being determined by the extent and rapidity of the movement of the brush. Each of the shafts 9 is also provided with a second cord or wire, 14, which is wound upon the shaft in the direction the reverse of the cords 55 56, and is connected to a spring or other retractile, 15, the tendency of which is to unwind the cord 14 and wind the cord 55, or 56, as the case may be. Each of the cords 55 56 passes between guides 16, located between the pen and the shafts 9, and the cords are provided with stops 17, which engage with the guides 16 and arrest the cords and limit the movement given to the shafts 9 and the brushes 12 by the springs 15.

The transmitting instrument is provided with two local circuits, *d*, which include local batteries *f* and the electro magnets *g* of a pair of pole changers, D E, Figs. 1, 5, 6, and 18, which are located, respectively, in the main circuits *b c*, and which act for a purpose, which will be hereinafter explained, to automatically change the polarity of the currents passing over the respective circuits whenever the movement of the transmitting pen in either direction is reversed.

The pole changers D E are of any of the common and well-known forms, and are connected to the two poles of the main batteries F and to the two wires of the respective main circuits *b c* in the usual manner. For the purpose of operating the pole changers the cords 55 56 pass around the pulleys 18, Figs. 1, 3, and 4, mounted upon shafts 19, which operate circuit makers and breakers included in the respective local circuits *d*. For this purpose the shafts 19 are provided with arms 20, which are frictionally connected to the shafts and have a limited movement between fixed stops 7. The arms 20 and one of the stops 7 of each arm are included in the respective local circuits, so that the rocking of the arms between their stops operates to make and break the local circuits, and thus operate the pole changers to change the polarity of the currents passing over the main circuits *b c* at each vibration of the arms.

The operation of the transmitter as thus far described is as follows: The operator will take the pen A in his hand and form the characters in proper sequence in the usual manner, moving the pen up and down and from left to right in forming the characters and writing the line, the same as in ordinary writing. As the pen makes the down strokes in forming the characters, the cord 56 will be unwound from the shaft 9 of the interrupter C, thereby revolving the shaft and moving the brush 12 over the disk 13, and interrupting the current over the circuit *c* repeatedly and in quick succession, the number and rapidity of the interruptions being determined by the speed and extent of the movement of the pen. As the

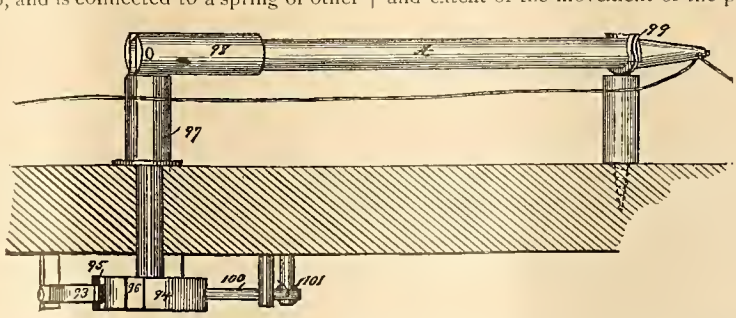

FIG. 10.

pen makes the up stroke the spring 15 will rewind the cord 56 and move the brush 12 in the reverse direction, interrupting the current in the same manner. So long as the up and down movement of the pen continues, the cord 56, acting upon pulley 18, will hold the arm 20 against one of the stops 7, and the local circuit *d* will remain closed, or broken, as the case may be, so that the pole changer E will not be operated, and the polarity of the current passing over the circuit *c* will not be changed. As soon, however,

as the movement of the pen is reversed—*i. e.*, changed from up to down or down to up—the movement of the pulley 18 will be reversed and the arm 20 will be rocked against its other stop, thereby changing the condition of the local circuit *d* and operating the pole changer so as to change the polarity of the current passing over the circuit *c*, and this change in the polarity of the current will take place as often as the up-and-down movement of the pen is reversed. As the pen is moved from right to left and left to right, the cord 55 and the spring 15 will operate the brush 12 of the interrupter B, to interrupt the current over the circuit *b* in the same manner, and the cord 55, acting on pulley 18, will act to close or break the other local circuit *d*, and thus operate the pole changer D to change the polarity of the current passing over the circuit *b* whenever the movement of the pen is reversed,

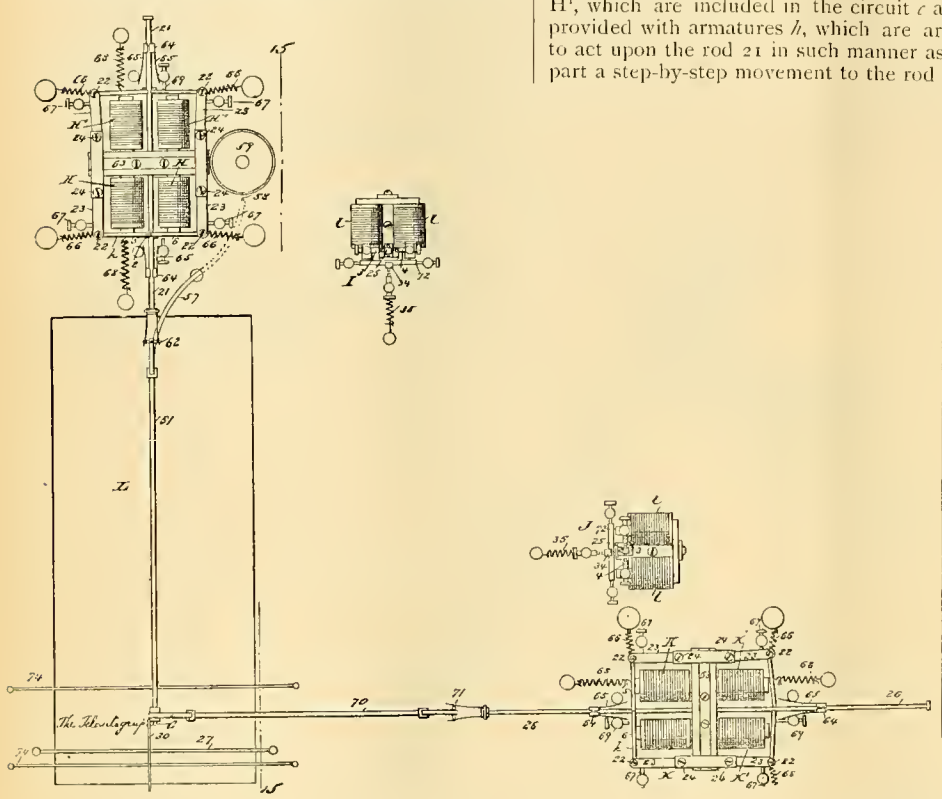

FIG. 11.

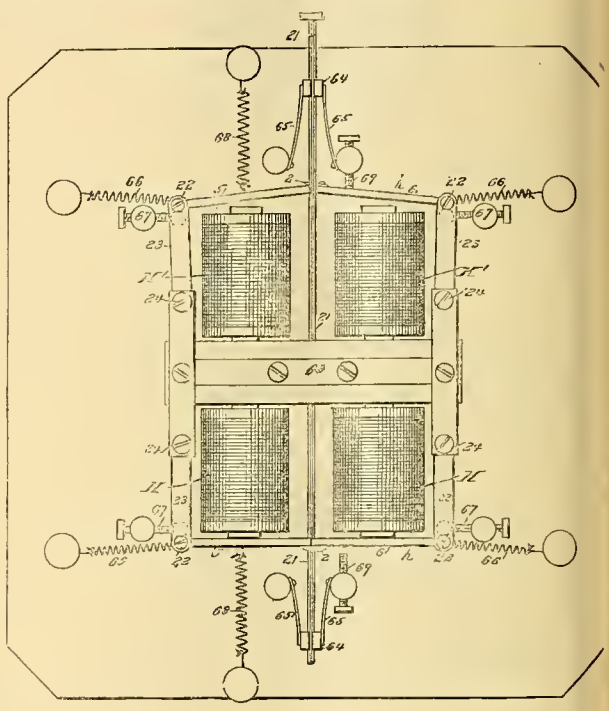

FIG. 12.

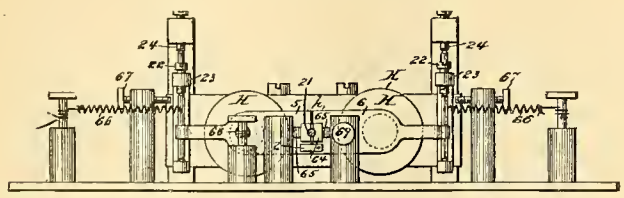

FIG. 13.

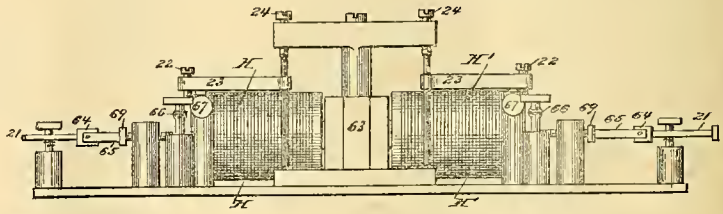

FIG. 14.

the same as described in connection with the pole changer E.

Referring to Figs. 11 to 18, the receiver consists, primarily, of the receiving pen G, which may be a writing instrument of any suitable form for recording the message. The term "pen" as applied to this instrument is therefore to be understood as including any form of writing instrument. In the case shown a fountain pen is employed, which is composed of a tube of very fine or capillary bore having its end formed into a writing point. The pen is connected by a piece of flexible rubber tubing 57 with a capillary tube, 58, which enters an ink well, 59, preferably located in such position that the surface of the ink in the well will be upon a lower level than the point of the pen.

To maintain the well at the proper height as the ink is lowered by use, it is provided with an adjusting screw, 60. By locating the ink well below the point of the pen it is found that the ink will be properly supplied to the pen by the capillary action of the pen and the tube 58, while if the well is located above the pen there is danger of the ink flowing too freely. The well may, however, be so arranged that the ink will flow to the pen by gravity, an arrangement to this end being shown in dotted lines at Fig. 15, suitable means being provided for regulating its flow; or the ink may be otherwise supplied to the pen. The pen is carried upon the end of an arm, 61, which is preferably tubular to receive the tube 57, and is connected by a universal joint, 62, to the end of a rod, 21, which is free to move longitudinally in a bearing, 63, but is retained in any position to which it is moved by means of frictional jaws 64, which are carried by light spring arms 65, and act to grip the rod with sufficient force to prevent its accidental movement, and also to overcome its inertia and arrest and hold it at the end of each step of its movement, as will be presently explained.

Located adjacent to the rod 21 are a pair of reversely arranged receiving electro magnets, H H', which are included in the circuit *c* and are provided with armatures *h*, which are arranged to act upon the rod 21 in such manner as to impart a step-by-step movement to the rod in opposite directions, according as one or the other of the magnets is energized. For this purpose the armatures *h* are divided at their centers, so as to form two parts, 5, 6, which are connected at their outer ends to pivots 22, so as to be capable of swinging to and from the cores of the magnets. The pivots 22 are in turn supported in frames 23, which are connected to pivots 24 in such manner as to swing laterally, and thus carry the two parts 5, 6 of the armatures to and from each other. The frames 23 are provided with springs 66, the tendency of which is to draw the two parts of the armatures away from each other, the movement of the parts in this direction being limited by back-stops 67. The movements of the two parts of the armatures away from the cores of the magnets is effected by means of a spring, 68, connected to one of the parts, the part not connected to the spring being provided with a lip, 2, of non-magnetic substance, which engages with the other part. The movement of the armatures in this direction is limited by an adjustable back-stop, 69. The rod 21 and the magnets H H' and their armatures are so arranged that the rod passes between the adjacent ends of the two parts 5, 6 of each armature in such manner that when the two parts of either armature are moved toward each other they will act to grip the rod between them, and, being then moved toward the magnet, they will carry the rod with them and impart a corresponding movement to the pen G.

The operation of the receiving magnets H H' and their armatures is as follows: Whenever the magnet H is energized by the closing of the circuit *c*, in which it is located, the two parts of its armature will be attracted toward each other, and toward the cores of the magnet. The springs 66 are so adjusted as to be slightly weaker than the spring 68, so that upon the magnet becoming energized and thus magnetizing the two parts of the armature they will move toward each other and grip the rod in advance of being moved toward the magnet. After gripping the rod, the two parts of the armature will move toward the magnet, thereby imparting a corresponding movement to the rod. As soon as the magnet is de-energized by the interrupting of the current over the circuit *c*, the springs 66 will draw the two parts of the armature apart, thereby releasing the rod, and the spring 68 will draw the parts back against the back stop 69. This operation will be repeated as often as the current over the circuit *c* is interrupted, so as to energize and de-energize the magnet H, and thus the rod 21 and the pen G will be moved with a step-by-step movement, the number and rapidity of the steps being determined by the number and rapidity of the interruptions in the current over the circuit *c*. The movement thus given to the pen G will constitute the upward movement of the pen in forming the characters. Whenever the magnet H' is energized and de-energized, the same operation will take place, except that the rod 21 and the pen will be moved in the reverse direction. From this it will readily be seen that in order to cause the up and down movements of the receiving pen G to conform to the corresponding movements of the transmitting pen A it is only necessary to cause the interruptions in the circuit *c*, occasioned by the movement of the brush 12 as the transmitting pen is moved upward, to de-energize and energize the magnet H, and the interruptions in

the same circuit, occasioned by the reverse movement of the brush as the transmitting pen is moved in the reverse direction, to de-energize and energize the magnet H¹. To effect this the circuit *c*, which, as before stated, includes both the magnets H H¹, also includes the magnet *l* of a polarized relay, I, Figs. 11, 16, 17, and 18, the polarized armature 25 of which is connected by a wire, *k*, with the circuit *c* between the magnets H H¹, while the contact points 3, 4, between which the armature vibrates, are connected to wires *m n*, which respectively connect with the 25, wire *k*, and through the magnet H¹, thus short-circuiting the magnet H and correspondingly reversing the movement of the pen G. By this means the receiving pen is caused to reproduce the up and down movements of the transmitting pen.

At some suitable point, preferably near the pen G, the rod 61 is pivotally connected to a rod, 70, which is connected by a universal joint, 71, to a rod, 26, which extends in a direction crosswise of the rod 21, preferably at or substantially at right angles thereto. Located adjacent to the rod 26 are two receiving magnets, K K¹, which are included in the circuit *b*, and are provided with armatures *h*, which are arranged and act upon rod 26 in exactly the same manner as the armatures of the magnets H H¹ act upon the rod 21, so that the energizing and de-energizing of the magnet K operates through its armature to move the rod 26 and the pen G from left to right, while the energizing and de-energizing of the magnet K¹ operates in a similar manner to move the pen in the reverse direction. The circuit *b* is provided with a polarized relay, J, similar to the relay I, which is arranged and acts to short-circuit one or the other of the magnets K K¹ whenever the polarity of the current passing over the circuit *b* is changed, the same as described in connection with the circuit *c*. The relay J is so arranged that so long as the transmitting pen is moved from left to right the current passing over the circuit *b* will pass through the magnet K and act to move the receiving pen in the corresponding direction, and that when the movement of the transmitting pen is reversed and the polarity of the current changed, the current will pass through the magnet K¹ and act to reverse the movement of the receiving pen.

It has now been explained how the movement of the transmitting pen along or at right angles to the line upon which the message is being written in either direction will cause the receiving pen to move in the same direction, the movements of the latter pen being made up of a series of short steps. From this it follows that any movement of the transmitting pen in any direction oblique to the line or intermediate these two directions will cause the receiving pen to move in a corresponding direction, but with a compound movement made up of a number of steps taken at right angles to or crosswise of each other, the relative number of steps in each direction depending upon the obliquity of the direction in which the transmitting pen is moved. By this means the receiving pen is caused to substantially follow any movement of the transmitting pen, and thus reproduce a substantial facsimile of whatever is written or traced by the latter.

The irregular or wavy character of the oblique lines made by the receiving pen will not

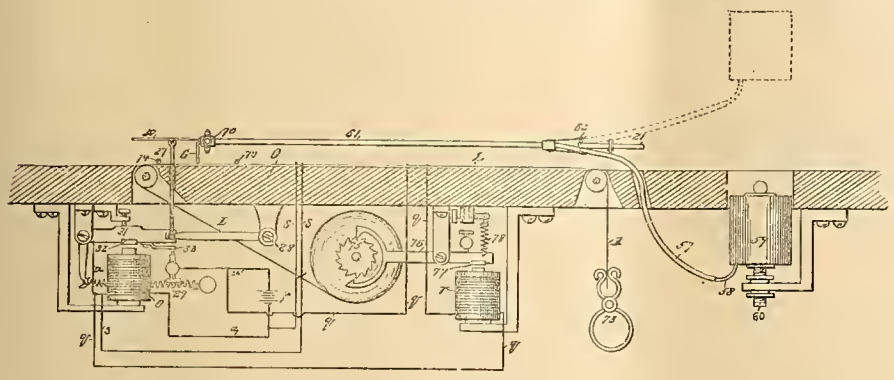

FIG. 15

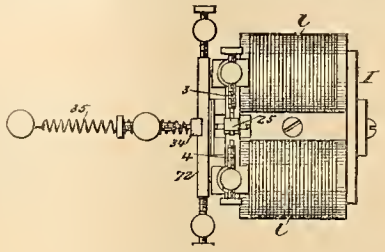

FIG. 16

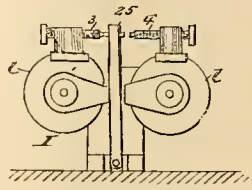

FIG. 17

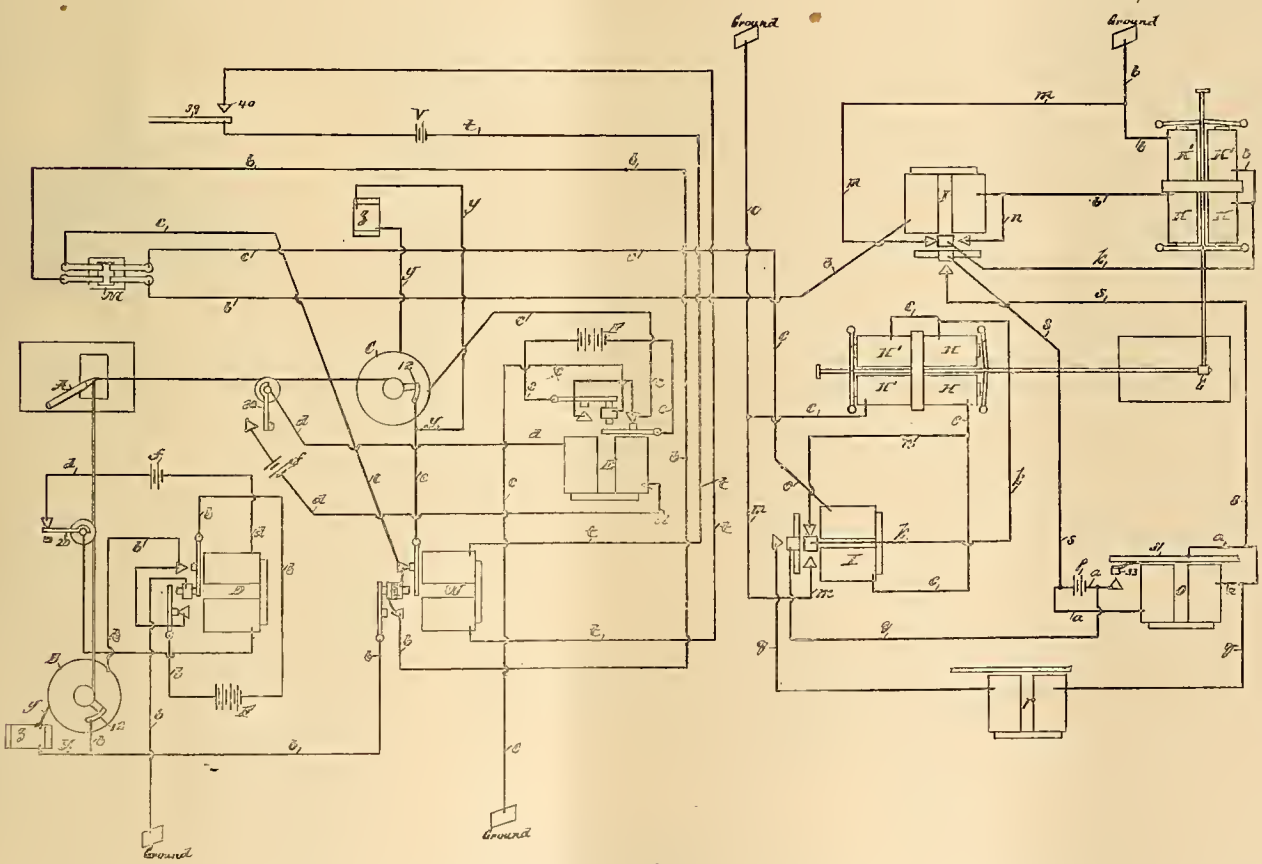

FIG. 18.

circuit *c* beyond the magnet H¹ and between the magnet H and the relay.

The relay I is so organized that the polarity of the current passing over the circuit *c* while the transmitting pen is moving upward will cause the magnet *l* to vibrate the polarized armature 25 into contact with the point 3. The current passing over the circuit *c* will then pass through the magnet H and over the wire *k*, armature 25, and wire *m*, thus short-circuiting the magnet H¹ and leaving the magnet H to be energized and de-energized, and thus move the receiving pen G in the same direction. As soon, however, as the movement of the transmitting pen is reversed, the polarity of the current passing over the circuit will, as before explained, be changed, and this will cause the magnet *l* to vibrate the armature 25 against the point 4. The current will then pass over the wire *n*, armature

detract materially from the appearance of the writing, and will not be sufficiently marked to prevent the handwriting of the person at the transmitting instrument from being readily recognized. The length of the steps with which the receiving pen is moved may be varied considerably; but the receiver will preferably be so adjusted that the pen will take from seventy-five to one hundred steps to the inch.

If it is desired that the characters formed by the receiving pen shall correspond in size to those formed by the transmitting pen, the receiver will be so adjusted that the receiving pen

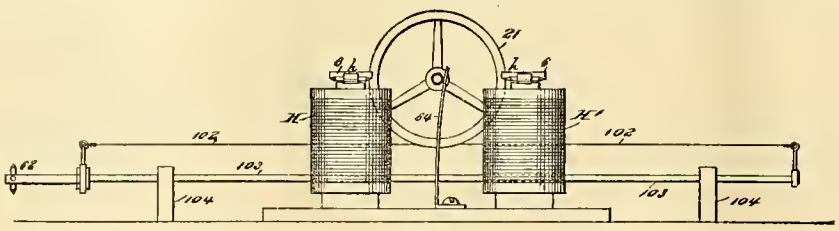

FIG. 19.

will at each interruption of one of the circuits be moved a distance equal to the movement of the transmitting pen required to effect the interruption. By changing the relative movements of the two pens the reproduction may be enlarged or reduced.

It has already been stated that it is important that the receiving pen should be so under the control of the operator at the transmitter that when he desires to break the connection between letters or words in the message, or to go back along the line for the purpose of making an addition, correction, or interlineation, or when he has completed one line and wishes to move the transmitting pen back to the point to commence a new line, the receiving pen will make the corresponding movements without making any mark on the paper. To effect this, the system is so organized that the operator can when he desires cause the receiving pen to be raised from the paper. The bore of the pen is so fine that no ink will flow from the pen except at such times as its point rests upon the paper, and thus when the pen is raised it will respond to the movements of the transmitting pen without producing any mark. For this purpose the receiver is provided with a vertically moving pen rest, 27, Figs. 11 and 15, which extends horizontally beneath the pen and is supported upon arms projecting from a rock shaft, 28, and provided with a spring or other retractile, 29, by which it is normally held in position to raise the point of the pen slightly from the paper. The pen rest 27 may be arranged to act upon the rod 61; but

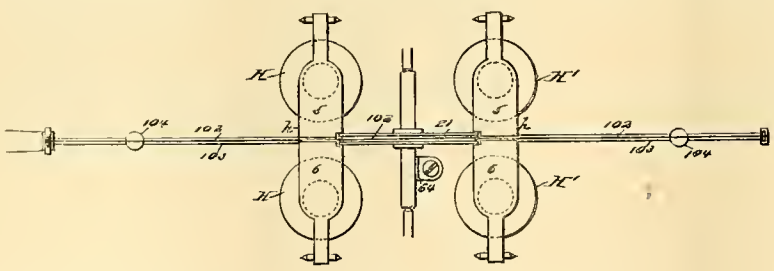

FIG. 21.

it will preferably be arranged to act upon a light extension, 30, projecting beyond the pen.

Acting upon the rest 27 is a pivotal arm, 31, which carries the armature 32 of an electro-magnet, *o*, of comparatively high resistance, which is included in a local circuit, *a*, which also includes a part of the arm 31, a circuit-closer, 33, carried by the arm, and a local battery, *p*. The local circuit *a* is provided with a branch, *q*, which includes an electro-magnet, *r*, of comparatively low resistance, and also a vibrating circuit-closer, 34, Figs. 11 and 16, operated by an armature, 72, which is acted upon by the magnet *l* of the relay I. The circuit-closer 34 is also acted on by a spring, 35, which tends to move it to position to complete the circuit through the branch *q*. The circuit *a* is also provided with a branch, *s*, which includes a reversely acting circuit-closer, 34, which is similarly arranged with relation to the magnet *l* of the relay J.

The transmitter is provided with a yielding table or platform, 36, Fig. 2, which is located directly beneath the point of the transmitting pen and extends over the entire range of movement of the pen. The table is supported upon arms 37, which are pivoted at 38, so as to permit the table to yield slightly when the point of the pen A is brought down upon it with a pressure equal or about equal to the pressure exerted upon a pen or pencil in ordinary writing. One of the arms 37 is provided with a forward extension, 39, which plays between stops 40, 42, which limit the movement of the table, and is provided with a spring, 41, the tendency of which is to normally hold the table in its raised position, with the arm 39 out of contact with the stop 40. The stop 40 and the arm 39 form a circuit-closer, which is included in a local circuit, *t*, which includes a local battery, *v*, and an electro-magnet, *w*. The armature 43 of the magnet *w*, Figs. 1, 7, and 8, is secured to a pivoted lever, 44, which is normally held against a back stop, 45, by a spring, 46, and carries upon its opposite sides two contact points, 47, 48, which are insulated from each other. Located upon opposite sides of the lever 44 are a pair of pivoted levers, 49, 50, which are provided with springs 51, which act to normally hold the lever 49 in engagement with the contact point 47, and in close proximity to but not in engagement with a back-stop, 52, and the lever 50 in engagement with a similar back stop, 54, and in close proximity to but not in engagement with, the contact point 48. Each of the levers 49, 50 is provided with an adjustable weight, 53, by which the inertia of the levers can be increased or diminished to any desired extent to secure the proper operation of the levers, as will be hereinafter explained. The lever 49, contact point 47, and back stop 52 are included in the main circuit *b*, while the lever 50, contact point 48, and back stop 54 are included in the main circuit *c*. The levers 49, 50 form reversely acting temporary circuit-breakers for the respective circuits *b c*, as will presently appear.

The operation of this part of the system is as follows: When the parts are in their normal position—that is to say, when the transmitting pen is not in use—the spring 41 will hold the table 36 in its raised position and the arm 39 out of engagement with the stop 40, so as to break the local circuit *t*, and de-energize the magnet *w*. So long as the magnet *w* is not energized the lever 44 will be held against its back stop 45, and the lever 49 will remain in engagement with the contact point 47, so as to close the circuit *b* at that point, and the lever 50 will remain in engagement with the back stop 54, so as to also close the circuit *c* at that point. So long as both the circuits *b c* remain closed the magnets *l* of the relays I J will both be energized, so as to attract their armatures and rock the circuit-closers 34 into position to break the connection through both of the branches *q s*, and the pen-rest 27, being then raised so as to raise the arm 31, the circuit closer 33 will be operated to break the local circuit *a*, and de-energize the magnet *o*, and the spring 29 will hold the pen-rest in its raised position, so as to raise the pen G from the paper and hold it in that position, and this will continue as long as the table 36 remains in its raised position. When it is desired to commence the transmission of a message, the operator takes the transmitting pen in his hand, and, moving it to the proper position to commence the writing, places the point against the table 36 and forms the characters with the same pressure on the pen as in ordinary writing. The pressure of the pen against the table acts to depress the table so as to rock the arm 39 against the stop 40 and close the local circuit *t*. This will energize the magnet *w* so as to rock the lever 44 and cause the contact point 48 to strike against the free end of the lever 50, and the blow thus given to the lever will cause it to swing away from both the contact point 48 and the back-stop 54, and thus temporarily break the main circuit *c*. The spring 51 will, however, act to very quickly overcome the inertia of the lever and its weight 53 and swing it back against the contact point 48, and thus again close the circuit *c*. The break thus made in the circuit *c* will be of exceedingly short duration; but the time between the breaking and closing of the circuit may be regulated with great nicety by adjusting the position of the weight 53 so as to cause the lever to swing a greater or less distance. As the lever 44 is rocked by the movement of the armature 43, as just described, the lever 49 will follow the movement of the lever 44 until it engages with its back-stop 52, so that the main circuit *b* will not be broken. The temporary breaking of the circuit *c*, caused by the swinging of the lever 50, will operate to de-energize the magnet *l* of the relay I, and permit its circuit closer 34 to be rocked by its spring 35, so as to close the local circuit *a* through the branch *q*. This will cause the current from the

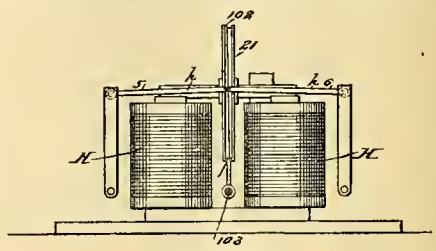

FIG. 20.

battery *p* to pass through the magnets *o r*; but the magnet *o* being of high resistance, and the magnet *r* of low resistance, the former will alone be energized, thereby rocking the arm 31 and depressing the pen-rest 27, so as to lower the point of the pen G onto the paper. As soon as the arm 31 is thus rocked the circuit-closer 33 will close the circuit *a*, so as to short-circuit the magnet *r* and circuit-closer 34, and the magnet *o* will remain energized, so as to hold the pen-rest depressed until de-energized by the raising of the transmitting pen, as will be presently explained. As soon as the circuit *c* is closed by the return of the lever 50 against the contact point 48 the magnet *l* of the relay I will be re-energized, and the circuit-closer 34 will be rocked, so as to break the connection through the branch *q*. Whenever the operator desires to break the connection between words or characters or to go back along the line for any purpose, or, having completed one line, wishes to commence a new one, he has only to raise the transmitting pen off the table 36, the same as in ordinary writing. As soon as the pen is raised from the table 36, the spring 41, acting upon the arm 39, will raise the table and at the same time rock the arm 39, so as to break the local circuit *t*. This will de energize the magnet *w* and release the armature 43, so as to permit the lever 44 to be rocked back against its back-stop 45, and as the lever 44 is thus rocked it will strike the end of the lever 49 and swing it, the same as has been described in connection with the lever 50, so as to temporarily break the circuit *b*, the circuit *c* remaining closed, the same as described in connection with the circuit *b*. This temporary breaking of the circuit *b* will operate to de-energize the magnet *l* of the relay J and permit its circuit-closer 34 to close the branch *s* and short-circuit, and thus de-energize, the magnet *o*, so as to release the arm 31 and permit the spring 29 to elevate the pen-rest 27 and raise the pen G from the paper, and at the same time operate the circuit-closer 33 to break the local

circuit *a*. The pen G will then respond to the movement of the transmitting pen, as already described, but without making any record upon the paper. The transmitting and receiving pens having been moved to the position where it is desired to recommence the writing, the operator has only to depress the point of the transmitting pen against the table 36 and the receiving pen will be lowered onto the paper, as already described. In order to prevent the magnets of the relays I J from being entirely de-energized, so as to release their armatures and thus allow the circuit-closers 34 to close the branches *q s* each time, the circuits *b c* are interrupted by the movement of the brushes 12 over the disks 13, the springs 35 are so adjusted that the amount of energy required to overcome their tension is much less than the energy required to operate the armatures *h* of the receiving magnets H H¹ K K¹, and the main circuits *b c* are provided with shunt circuits *r*, which connect with the main circuits upon opposite sides of the interrupters, and include resistance coils or other resistances, *z*, which are so adjusted as to allow a constant current to pass over the main circuits sufficient to energize the magnets *l* to overcome the springs 35, but not sufficient to operate the armatures *h*. It is to be understood, therefore, that when the circuits *b c* are referred to as being broken or interrupted by the interrupters B C it is not to be understood that those circuits are necessarily completely broken, so as to entirely stop the currents, but only that the currents are

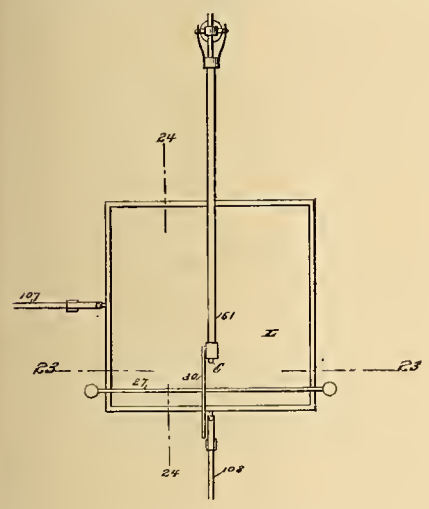

FIG. 22.

sufficiently interrupted to release the armatures of the receiving magnets.

From the foregoing it will be seen that all of the movements required to form the individual letters or characters, and also to bring them in proper position one after another to form the words of a line, are made by the receiving pen, the paper remaining stationary during the writing. When, however, one or more lines have been written, it is necessary that the paper should be shifted so as to bring a new portion into position to be written upon. If the message is to be written in the form of a single line extending along the length of a narrow ribbon of paper, the paper must be shifted longitudinally the length of the line which has been written, so that when the writing is resumed it will continue from the point on the paper where it was interrupted. If, on the other hand, the message is written in lines extending across a sheet or wide ribbon of paper, the paper must be shifted forward a distance equal to the space between one or more lines. In either case it is important that the mechanism for shifting the paper in the receiver should be under the control of the operator at the transmitter.

As herein illustrated, the message is written in the receiver upon a wide ribbon of paper, L, which is supported at rest upon a stationary paper support, O, while the writing is in progress. The paper L is led from a roll, and after passing over the support O, beneath the point of the pen, passes downward out of the instrument, where it is attached to a clip, 73, of sufficient weight to maintain it at the proper tension and to draw it off the roll when the latter is permitted to turn. Suitable guides, as 74, will preferably be provided to hold the paper smoothly and evenly beneath the pen. The roll upon which the paper is wound is provided at one end with an escapement wheel, 75, which is controlled by an escapement lever, 76, to which is attached the armature 77 of the magnet *r*, the lever 76 being so arranged that when rocked by the action of the magnet it will permit one tooth of the escapement wheel to pass and the weight 73 to unwind and shift the paper L. The escapement lever 76 is provided with a spring or other retractile, 78, which, as soon as the magnet *r* is de-energized, will rock the lever in the opposite direction, and thus permit another tooth to pass and the paper to be again shifted. The move-

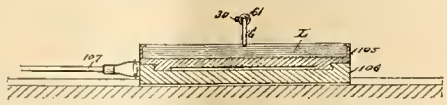

FIG. 23.

ment thus given to the paper each time the magnet *r* is energized and de-energized, is equal to the space between two lines.

It has already been explained that whenever the circuit *c* is temporarily broken by the action of the lever 50 the current from the local battery *p* is caused to pass through the magnet *r*, but without energizing it. If, however, both the circuits *b c* are simultaneously broken, the branches *q s* of the local circuit *a* will both be closed and the current from the battery *p* will pass over the wires *a q s* and through the magnet *r* without passing through the magnet *o*, and the result will be that the magnet *r* will become energized, so as to attract its armature and rock the escapement-lever 76 to allow the paper L to be shifted, as described.

For the purpose of simultaneously breaking both the circuits *b c* to effect the shifting of the paper L when desired, the transmitting instrument is provided with a circuit-breaker, M, Fig. 2, by which the operator can when he desires break both the circuits *b c* simultaneously. For this purpose the circuits *b c* include contact springs or brushes 79, which rest upon a pair of metallic blocks, 80, set in a head, 81, of insulating material, which is carried upon a shaft, 82, having a handle, 83, which is in convenient position to be moved by the operator. The shaft 82 is acted on by a spring or other retractile, 84, which normally holds the shaft and head 81 in such position that the blocks 80 connect the brushes 79 and close the circuits *b c*. By operating the handle 83, however, the shaft can be given a partial turn, so as to carry the blocks 80 out from under the brushes 79, and thus break both the circuits and effect the shifting of the paper L.

In the practical operation of the system it will usually be desirable to make a copy or duplicate of the message at the sending station, and for this purpose the transmitter is provided with a wide ribbon of paper, N, similar to the paper used in the receiver, which is also supported at rest while the writing is in progress. The paper N is led from a roll and passes forward over the table 36 beneath the transmitting pen, and after passing over a roll, 85, mounted upon the shaft

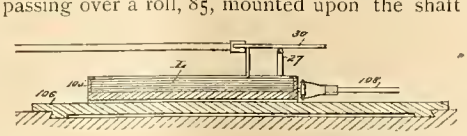

FIG. 24.

38, is led from the instrument. A guide, as 86, will preferably be provided, which will operate to hold the paper smoothly beneath the pen. To effect the shifting of the paper N, the roll 85 is provided with a small co-operating spring-pressed roll, 87, which is journaled in the arms 37, and between which and the roll 85 the paper passes. The roll 85 is provided with a ratchet, 88, which is engaged by a pawl, 89, carried upon one end of a lever, 90, the other end of which is connected by a rod, 91, with an arm, 92, upon the shaft 82 in such manner that whenever the handle 83 is operated to break the circuits *b c* and effect the shifting of the paper L the pawl 89 will also be operated to shift the paper N a corresponding distance.

The general operation of the system is as follows: The instruments having been supplied with the paper L N, the operator will take the transmitting pen and, holding it out of contact with the paper N, move it to the point over the paper where he desires to commence the writing of the message. As the transmitting pen is thus moved, one or both of the brushes 12 will be moved, so as to interrupt one or both of the circuits *b c*, and thus, through the magnets H H¹ K K¹ and their armatures, move the receiving pen to a corresponding position over the paper L, the receiving pen being raised out of contact with the paper by the pen-lifter 27. The operator will then place the point of the transmitting pen upon the paper, as in ordinary writing, and as soon as the transmitting pen is pressed upon the paper the table 36 will be depressed, thereby closing the local circuit *t* and through the connections which have been described depressing the pen-rest 27, so as to lower the pen G onto the paper. The operator will then write along the line in the usual manner, and the movements of the transmitting pen in forming the characters and in moving along the line will operate the brushes 12 to interrupt the circuits *b c* and the arms 20 to change the polarity of the currents passing over the circuits, and thus energize and de-energize the respective magnets H H¹ K K¹ and cause the receiving pen to follow the movements of the transmitting pen with a step-by-step movement, and thus reproduce the message. If at any point in the line the operator wishes to break the connection between characters or words or to go back on the line to make an addition or correction, he will raise the transmitting pen from the paper. This will allow the table 36 to be raised and break the local circuit *t*, and through the connections which have been described de-energize the magnet *o* and allow the pen-rest 27 to raise the receiving pen from

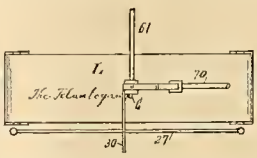

FIG. 25.

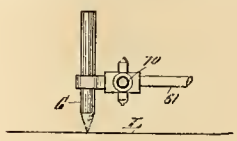

FIG. 26.

its paper. By then moving the transmitting pen to the desired position and lowering it onto the paper the receiving-pen will be moved to and lowered onto the paper in a corresponding position. At the end of a line the operation will be the same. When a line has been completed and it is desired to commence a new line, the operator will, either before or after moving the transmitting pen into position to commence the new line, operate the handle 83, so as to shift the paper N and at the same time break both the circuits *b c*, and this will through the connections which have been described energize the magnet *r* and operate the escapement to correspondingly shift the paper L.

In a practical embodiment of the system it will usually be necessary to have a transmitter and a receiver located at each station, so that messages can be both sent and received at any station, and in such case it will of course be desirable to utilize the line wires of the circuits *b c* for both sending and receiving. This can readily be done by providing a switch apparatus at each station, by which the transmitter and receiver can be switched into and cut out of the circuits at pleasure. One form of switch apparatus suitable for this purpose is illustrated in the present case. For this purpose the line wires of the circuit *b c* Figs. 9 and 10, (are connected to spring contacts) or brushes 93, which rest upon the periphery of a rotary switch, 94, having two pairs of contact blocks, 95, 96, which are connected respectively to wires *b c* which lead to the receiver, and to wires *b c* which lead to the transmitter. By turning the switch 94 until the brushes 93 rest upon the blocks 95, the receiver will be switched into the circuits and the transmitter cut out, and vice versa. In the practical

(*Continued on page* 73.)

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CONTENTS OF THIS NUMBER.

PAGE.

Sperry Double Induction Motor, Illustrated 65
Incandescent Lamps at the Cincinnati Exposition 65
Largest Telephone Exchange 65
Chicago Electric Club 65
Gray's Telautograph, Illustrated 66, 67, 68, 69, 70, 71, 73
Editorial 72
Prof. Dolbear and The Telephone 73
Gravity Drop Annunciator, Illustrated 73
High Tension System Before the Board of Electrical Control, Part III.
Harold P. Brown's Reply 73, 74, 75

DEPARTMENTS.

Correspondence 75, 76
The Electric Light 76
The Electric Motor 77
The Telephone 77
The Telegraph 77
Electrical Patents 77, 78

THE CABLE of the North Side railway of Chicago has broken so many times that the residents of that section of the city have formed a protective association. The particular grievance of which the north siders complain is that they are compelled to pay two fares if an accident to the grip or the cable compels them to change cars. The new association proposes to institute suits by the wholesale for the recovery of extra fares.

WE DEVOTE a large amount of space this week to a full description of Professor Elisha Gray's telautograph. The instrument is one which has awakened great interest and we believe the exhaustive manner in which we have illustrated it will be appreciated by our readers.

It will be noted that throughout the inventor has exercised great skill, even upon the smallest details and that the patent specification covers specifically the most minute points. It is very clear that the professor proposes to protect this invention to the utmost.

A SHORT TIME AGO Mr. and Mrs. Heesch were found dead in their home, in Chicago. The husband had committed suicide, apparently, but the death of the wife formed a mystery. Some excitement was caused at police headquarters by an amateur detective, who brought in the report that the woman's death had been caused by a shock from an electric battery. The detectives then went to work and developed their theory as follows: They found that the couple suffered from rheumatism, and were in the habit of using a battery for treatment. They concluded that on the fatal Saturday night the wife asked her husband to help her use the battery. He complied, and by accident, turned on the full strength of the electric current, giving the unfortunate woman such a shock that she fell back, dead. Realizing that he had been the cause of her death, the frantic man—so the detectives thought—took his own life.

Unfortunately for their theory, the detectives called into their counsels an electrician, and exhibited to him the electric battery which had been found on the premises. He assured them that the combined effect of 1,700 batteries of that kind might prove fatal in some cases, but that the use of the apparatus shown him could not be attended with any serious results.

AN article in another column gives an idea of the important part which electric lights play in the decoration of the buildings used for the centennial exposition at Cincinnati. The fact that the incandescent lamp can be employed so easily and effectively for this purpose is a great argument for its use, especially in all public buildings. Electricians are beginning to appreciate more and more the importance of this fact in their arrangement of lights. There will be few lamps hereafter stuck about stiffly, but the globes will be so placed that they will serve as ornaments as well as displace gas.

AN argument in favor of the underground system of distributing electricity appears in the New York correspondence. A thief who represented himself as a lineman went to the roof of a house and thence obtained access to an adjoining building where he appropriated $400 worth of valuables. Several instances of this kind have been reported in the last few months. In one case the bogus lineman succeeded in decamping with several thousand dollars' worth of jewelry. With an underground system such robberies, of course, would be out of the question, and it may be expected that this argument will be pressed by the opponents of overhead wires.

HAROLD P. BROWN, who criticised the alternating system so severely, replied to his critics last week, and gave a series of experiments to demonstrate the correctness of his former strictures concerning dangerous currents. The first part of his extended reply is printed elsewhere. Mr. Brown claims that he has been unjustly treated and badly misrepresented by the electricians who answered his letter. The experiments, as conducted in the presence of spectators, were unsatisfactory, especially as an officer of the Society for the Prevention of Cruelty to Animals put an end to the torture of the poor brute who was suffering from repeated shocks from continuous and alternating currents.

C. W. DEAN, who speaks once each week at the Church of Nature in Chicago, has curious ideas concerning the formation of the earth. His statements, in fact, sound like extracts from that marvelous lecture on the "Hiding Places of the Winds," delivered the country over by a colored scientist. Mr. Dean says: "You see the earth was originally composed of electricity, with a mica shell about a quarter of a mile thick. Mica is condensed electricity. By making the earth in the shape of an egg and then causing it to revolve it turns the electricity over in the middle and makes two pulsations a day. You wouldn't suspect it, but these pulsations are very necessary, and but for them the earth would balk and stagger."

REPORTS that improved methods of obtaining aluminum at a cost almost nominal have been discovered are becoming numerous. The most reliable report is that which states that by a process employed at the Krupp gun works near Cologne the metal is obtained at a cost of twenty-five cents per pound. The prevailing price has been about $5 per pound. Some one recently said in communicating on these alleged discoveries that the present is the beginning of the "aluminum age," and it was prophesied that the metal would soon revolutionize methods in the practical arts for the reason that the material roughly is as strong as steel while it is almost as light as chalk. Any process which will tend to cheapen aluminum will greatly interest electricians.

CONSIDERABLE difference of opinion exists between the eastern reporters and Jay Gould in reference to the latter's health. Mr. Gould, in a recent statement, declares that his physical condition is excellent, but the papers insist that he is in great danger. They allege that it is absolutely necessary for him to dispose of his immense business interests in order to prolong his life. Among the latest modes which have been figured out to enable him to escape the responsibility of looking after the affairs of the Western Union is a statement that he will sell his interest in the company to a syndicate which will form a telegraph trust. It is asserted that the recent advance in thecable rates is "one of the preliminary steps in Mr. Gould's grand scheme of retirement from the Western Union." Most persons will require considerably better evidence before they even take interest in these reports. Certainly they are not credited in Wall street.

IT IS ASSERTED that the law which provides for electric executions in New York state is defective in many respects. The Albany *Times* says that there is no official charged with authority to purchase necessary apparatus, that there is no plan officially designed for the requisite appliances, and that there is no money appropriated for the purpose of securing plans or constructing apparatus. The same paper says: "There is no possible way by which the proper legal officer can put a criminal to death under the new law, unless he takes it on himself to rig up some temporary appliance of electrical conductors and work them on the unhappy criminal in any hap-hazard way he can, regardless of the awful possibilities on the executioner and the spectators which unguarded electric currents may work. * * * The legislature will find it necessary to pass another act describing explicitly the kind of machine to be used, and appropriating money to pay for it. As the law and the legislature go into operation on the same day, there will be an interesting interval wherein the first murderer of 1889 will have the blissful doubt as to whether he is to be bungled out of this life by some rude impromptu contrivance, or dispatched with reasonable assurance of ease and comfort by expert appliances." Certainly no one desires to see any bungling with apparatus by persons unacquainted with electrical matters. The law was passed in the name of humanity and the most exact preparations should be made to carry into effect capital sentences by the new mode.

THE Chicago *Daily News* relates the experience of "a gentleman connected with one of the elevated projects for the west side who recently spent considerable time in an investigation of electricity as a motive power." The result of this gentleman's experience was, according to the *News*, that "without a single exception, none of the electrical roads were claimed to be meeting the expectations of their promoters, and so far as heavy traffic is concerned are yet utterly impracticable. This includes the electrical roads at Richmond, Va., Scranton, Pa., Minneapolis, Kansas City, and a number of other cities. In every case the electrical motor, while feasible for single cars and light traffic at moderate speed, has failed to demonstrate its applicability to large cities. The engineers who have made a special study of the electric motor all agree that it is yet but an experiment. It is hoped that the time will come when electricity can be applied as a motor to elevated or other trains, but that time has not yet arrived. The storage battery, from which so much was expected, has been practically abandoned in the field of experiment, and the most successful method yet employed is the old-fashioned electric wire running parallel with and above the cars."

In the face of the remarkable extension of electric railway systems at the present time this statement seems the wildest absurdity. Almost daily reports from practical railroad managers are published, in which they admit that an exhaustive examination of electric roads demonstrates their practicability and their eminent superiority over all other kinds of street roads. The reports of railway companies which have adopted the new motive power are fairly enthusiastic in their praise of the new system. The electric road is not perfect yet perhaps, but it is by far the best system yet devised and street car managers are beginning to appreciate the fact the country over. Indeed, the entire statement quoted is manifestly so far from the truth that it would not be worth mentioning were it not for the fact that it is published in Chicago where persons are usually so enterprising that they know a good thing when they see it.

(*Continued from page 71.*)

operation of the system it is also important that means should be provided which will make it certain that the receiver at any station will be switched into the circuits at all times, except when the transmitter at that station is in use. To insure this, the shaft 97, upon which the switch 94 is carried, is provided with a socket, 98, which is adapted to receive the one end of the transmitting pen, and the instrument is provided with a stationary fork, 99, which is adapted to receive and support the other end of the pen. The fork 99 is so positioned that when one end of the pen is inserted into the socket 98 and the other end rests in the fork of the switch 94 will be in position to connect the receiver to the line wires of the circuits. By this means it is only necessary for the operator when he has finished using the pen to place it in the pen rack or receiver formed by the socket and fork to insure the proper connection of the receiver to the circuits, and a glance at the transmitter will show at any time whether or not the proper connection exists. This feature is of particular importance when the system is employed for ordinary business purposes, and is not operated by specially skilled operators. Whenever the transmitting pen is removed from the pen-rack, it will usually be for the purpose of transmitting a message, and in such case it is of course necessary to shift the switch 94 so as to connect the transmitter to the line wires. To effect this automatically, the shaft 97 is provided with an arm, 100, which is acted on by a spring or other retractile, 101, in such manner that when the shaft is released by the lifting of the pen from the rack the spring will act to shift the switch into position to connect the transmitter with the line wires and maintain that connection until the switch is again shifted by the replacing of the pen in the rack.

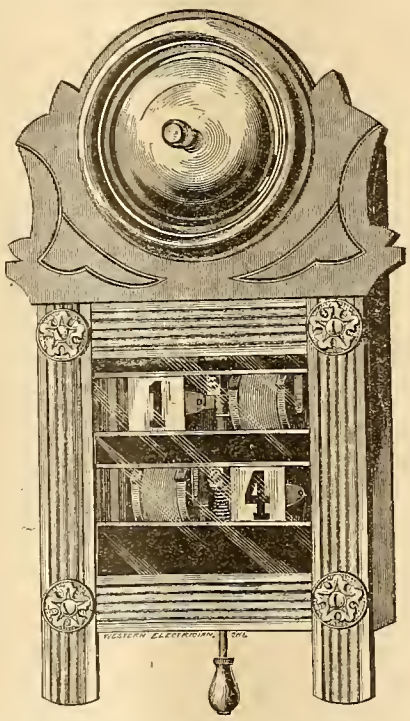
Prof. Dolbear and the Telephone.

The following is an extract from Prof. Dolbear's lecture on "Recent Advances in Electrical Science:" "It is now twelve years since it was heralded that Prof. Bell had succeeded in electrically transmitting speech, and not quite eleven years since it began to be commercially used. Its rapid introduction has been due more to the method of doing business in vogue and to business management than anything elre. The centennial telephone consisted of an electro-magnet with its armature so mounted as to permit one to speak or to listen to it. Bell proposed to speak to the armature of an electro magnet and have another person hear what was said by listening to the armature of another magnet in the same circuit. This was a new experiment with old apparatus, and to Prof. Bell is due whatever of merit belongs to it. It was the opinion of those electricians who were cognizant of Prof. Bell's work that though the electrical effects he looked for would follow, yet the sonorous effects would be too weak for the audible transmission of speech. In this they were mistaken, as experiment proved, but it was too weak for commercial use, and but for subsequent changes in both method and apparatus it would have remained a curious toy, as the phonograph has been for ten years. Words could be transmitted, but 'not with distinctness sufficient to every one,' yet it was rightly considered to be a great achievement, not so much on account of what it would do as to the manner of doing it. In 1861 Philip Reis of Germany undertook the same problem of electrically transmitting speech, but in an entirely different manner. He made the sound vibrations move the electrodes of an electric circuit and vary the resistance, instead of making them vibrate the armature of a magnet; and he employed an electro magnet for a receiver as Bell did fifteen years after. Much stronger effects could be got with Reis' device than with Bell's. The record says that sounds of all kinds could be transmitted, that 'words even were transmitted, but not with distinctness sufficient to every one,' which was the case with the centennial telephone. After the '76 exhibition the electro magnet telephone was abandoned. The permanent magnet telephone—an invention of mine, was substituted for it and is still in use to-day. Instead of using the receiver for a transmitter, Reis' transmitter was adopted and a knob of carbon took the place of the platinum such as Reis used, so that to-day the *method* of Reis is used in conjunction with my permanent magnet receiver. Bell's centennial telephone justly brought him great renown.

"In 1879 I invented another method and apparatus different from Reis' or Bell's, and expected that such departure from anything that was shown or known in 1876 could be used without obligations to that patent. The Supreme court to which the case was appealed decided that Bell discovered a new art and was the first inventor of a speaking telephone. They denied that Reis invented a speaking telephone in spite of the history. Now that a large body of competent men who are acquainted with both the history and the apparatus, declare that he did not invent a speaking telephone, that a number of competent witnesses, among whom are Prof. Quincke of Heidelberg, declare that they heard it transmit words in Reis' hands, and as the German government pay a pension to Mrs. Reis because her husband invented the speaking telephone, it is permissible to hold that the court was mistaken in its historical judgment, and if it was mistaken, justice has miscarried."

Gravity Drop Annunciator.

The accompanying cut illustrates the form of gravity drop annunciator manufactured by the Central Electric company of Chicago.



The core is extended to the edge of the spool on each side by means of iron lugs which are riveted to the core and in this way it is possible to do away with weights and springs. In its normal condition the drop or shield rests against the back of the case horizontally. When the current is passed through the coil, the lugs above mentioned become magnetized and the drop, which is substantially the armature, is attracted past the center of gravity, and as soon as the current is released the shield drops by gravitation to the point where it meets the view.

The drop is said to occupy the least space in the case of any shield drop yet in practical operation, requiring the case to be but $1\frac{3}{4}$ inches deep. The surface space occupied is $1\frac{1}{2}$ by $1\frac{3}{4}$ inches. The shield is pivoted to the ends of core and swings on these bearings. The annunciator is so made that the front can be taken off or swung back, leaving the interior.

A dispatch from New York of last Monday says: Henry De Dolter, a well known electrician residing at New Brighton, Staten Island, left his home for this city a week ago and since then has not been seen. De Dolter has been engaged upon some intricate problem affecting his profession, and his frends fear he has become temporarily insane. When he left home he carried a small amount of money with him and a valuable watch and chain. The body of an unknown man was found in the North River to-day and sent to the morgue. In several particulars it resembled the description of the missing man, but no person calling succeeded in identifying it.

High Tension System Before the Board of Electric Control.

PART III.

Seventy-five persons make a rather large audience to gather in New York on a summer afternoon, but by throwing a veil of mystery around his proceedings, Harold P. Brown, electrical engineer, succeeded in securing an attendance of about that number in the physicial laboratory of Columbia College on July 30th. Invitation cards had been issued to the press, to the Board of Electrical Control, and to representative electricians of New York and vicinity. The object of the meeting was to prove that Mr. Brown was correct in his recent assertion that the public safety demanded the prohibition by law of the commercial use of electric currents exceeding a certain voltage. In order to demonstrate the comparative effects upon animal life between high tension continuous and high tension alternating currents, elaborate preparations had been made, although, as the sequel showed, the results obtained were by no means satisfactory. Mr. Brown opened the proceedings by reading the following reply to his critics:

HAROLD P. BROWN'S REPLY

Gentlemen:—I appear before you in behalf of the many men who have met sudden and violent deaths from electric light machinery. Not only have they been robbed of life, but their memory has been blackened by the accusation of foolhardy carelessness from the testimony of the employers and associates. I do not mean to say that none of these men have been responsible for the accidents that have killed them, but I do say that in every case their employers have sought to evade responsibility by throwing the blame on the dead man who cannot defend himself, so, if these reports are to be believed, it is as disgraceful to be killed by electric currents as it is to meet death by blowing in the muzzle of a gun to "see whether it is loaded." In the case of Lineman Murray I quote from the *Herald* of May 12th in an interview with the superintendent: "He removed the insulation from one of the wires with something, probably his knife. I do not know why he did so, for it was not necessary. When he removed the insulation he cut into the wire, as is shown by the freshly cut copper, and then must have made a contact with the iron cornice and the current passed through his system. His experience ought to have taught him the danger of what he was doing." Murray might have taken hold of the bare wire, without any injury had there been no other ground connection upon that circuit, or had the wire been perfectly insulated throughout its length; he had no means of knowing that there was a ground on the circuit, and it was the company's duty to see that the line was clear from grounds; he had no means of knowing that the cornice was grounded.

I quote from the *Electrical World* of July 28th: "At Halifax some time ago, a lamp trimmer climbed a pole to trim a lamp. The current, it seems, was on. By carelessness we will assume, he took hold of both wires and was instantly killed. The next day, or day after, a second man was in like manner killed. They thought they knew all about it. It is said, and, if it is true, ought to be unconditionally condemned, that the electric light company are running some ninety lamps and about 4,000 volts on this circuit, by reason of which they save the wire necessary to divide the lighting into circuits. Such economy is criminal in the extreme."

Of course these deaths are assumed to be from carelessness, beeause the "company" says so. But the last sentences quoted show that the poor fellows were in no way to be blamed. In any case if it is necessary to carbon the lamps when the current is running, it is the company's duty to supply each lamp with a switch that will cut the lamp entirely out of the circuit.

On May 6, 1887, J. T. Simpson, engineer in the Adams Express Building, was killed by putting his hand on the circuit while standing on the floor A week or so ago another engineer was killed at the same place and in the same manner, and I do not suppose that the company which installed that plant has even yet seen fit to notify its owners that their circuit is probably grounded.

But it is unnecessary to multiply cases, as the press has been led to believe from statements of superintendents and managers of electric lighting companies that death from electricity is necessarily from the carelessness of the man killed. For a long time I have felt that it was my duty to "tell the truth" in the hope that it would lead to the adoption of safety devices, and better insulation, and as case after case was published I have felt guilty because I had not the courage to do so. Finally when young Streiffer was killed on April 15th by touching a straggling telegraph wire, and the following day two telephone wires dropped in the street in front of my house, I could keep silence no longer, and I wrote an article calling attention to the causes of death from electric lighting, and suggesting means for rendering fatal accidents less frequent. In the course of this article I could not refrain from stating what I thought of the system of operating incandescent lights in our homes by means of alternating currents far more dangerous than those for operating arc lights in the streets and in stores, where the wires are ordinarily out of our reach. I knew that the letter would cause a terrible outburst of indignation against me on the part of the wealthy and powerful "combine" of corporations which is exploiting the alternating system, but I believed that I was right, and therefore had the courage to state what I considered to be facts. Having written the letter and submitted it to several friends for criticism, I tried to get it published, never anticipating any difficulty in that respect, since the object was public safety. The assistant city editor of a prominent morning paper seemed to be glad to get it. After waiting for awhile I called upon him, and he said he was very sorry, but the fact was that he could not use the article. Warned by this,

I obtained letters of introduction to the manager of another prominent morning paper and stated the case to him. He agreed at once to publish it. I waited for some time and then sent a friend, who was well acquainted with an assistant editor, to ask after it. The reply was that if the part of the article referring to the alternating currents was omitted it would be acceptable; if I insisted upon having it published as it was, it should go in, but he would advise me not to do this. By this time two more deaths had occurred and I rewrote the article and took it to the editor of the *Evening Post*, who kindly published it. It was my intention to demonstrate with arc light lighting machinery the exact truth of my statements and the value of my suggestions, and this I shall do on a future occasion, but a few days after my letter was published an anonymous correspondent attacked me in a letter to the *Post* written in the interest of the alternating current system.

On June 8th, at a meeting of the Board of Electrical Control, Commissioner Daniel L. Gibbens read my article and offered a resolution, which was adopted, that it be published in the minutes and a marked copy sent to various electric lighting companies and others, asking their opinion in writing, or their appearance before the board to discuss the matter. This meeting of the board was deferred until July 16th, and as I was in Virginia on that date I wrote that I was unable to attend, but would invite the board and those interested to meet me at a later date. At this meeting many letters were read; those from Ralph W. Pope and Prof. Henry Morton were written in a scientific spirit and were dignified and gentlemanly, as would be expected from men of their standing. But all the other letters were from persons in the employ of the alternating systems and were bitter personal attacks upon me, instead of scientific discussions of the subject.

After these attacks, to which I shall refer in detail later, there remained but one thing for me to do to clear myself; words are no avail against such accusations as theirs. I must show from their own current, and its effects upon life as compared with continuous currents, that my statements are true. I therefore made preparations to demonstrate the character of alternating currents so that they could no longer claim them to be safe and harmless, and, in all honesty and fairness, sent invitations to the men who had attacked me, to be present this afternoon and learn what alternating currents could do. I blush for my profession when I tell you the next move of the opposition, and there are two gentlemen in this room who can prove the truth of my statement. Having done all they could to publicly blast my reputation and stamp me as an ignorant impostor in electric engineering, they tried to invoke the law to prevent my disproving their charges by a demonstration. After trying to rob me of my means of obtaining a living, for I am not in the employ of any company, corporation or individual, they propose to gag me by appealing to the law. In spite of this affront, I shall invite the representatives of the alternating current who are present, to appoint a committee of three to come forward when I deal with their current, test all my connections, check up my measurements with their own instruments, and see that I am not deceiving in any of my experiments. But I do this upon the condition that if they make a counter demonstration they will afford me the same privilege and give me the same notice that I gave to them.

I do not propose to present a scientific paper to you this afternoon, but will simply give you a few samples of the experiments I have been engaged in for a considerable time, in order to determine the death points of continuous, pulsating and alternating currents, and will reserve the report of the same and the conclusions to be drawn from them, for the subject matter of another paper. Dr. Frederick Peterson, who has had many years' experience in diseases of the nerves, has assisted me by dissecting some of our subjects and making microscopical examinations. He will do the same this afternoon, if any of our experiments with the alternating or continuous currents have a fatal ending, and will read to you a brief paper on the subject.

I have invited the representatives of the press as a means of affording protection to the public, since the alternating current people claim their system is perfectly safe, and if it is not safe, the public should be warned of it so that they can be on their guard when they encounter it. I hold that all currents with an electromotive force (or pressure) of 500 volts or more are dangerous to life and should be surrounded with all possible precautions; and apparatus can be made which will render both the continuous and pulsating currents safe in ordinary use; that apparatus has not been invented that will make alternating currents equally safe.

Therefore if the press and the public understand the conditions and insist that the pressure of the alternating current be reduced to safe limits until some safety device is invented for higher pressures, it will not be long before some such invention is forthcoming. Not many years ago the sudden growth of the telephone business and the great number of wires over buildings and on poles, led the press to demand that they be placed underground. At once all the telephone experts protested that it was impossible; telegraph wires could go underground but not telephone wires. The press hammered away on the subject and, as a result, many cities prohibited the extension of pole lines. Then the telephone men discovered means of operating their wires underground and such lines appear to give better results than the old ones. It was the same way with the underground electric light wires. All the experts protested not long ago that it could not be done; if it was insisted upon they would all have to go out of business and their investments would be worthless. Mainly through the insistance of the press some cities would permit no electric light lines on poles. In these places the wires went underground and are working with apparent success. It is simply the matter of the amount of money expended upon insulation and the care with which the water is kept out of the joints.

Now if I can convince the Board of Electrical Control and the press representatives that the alternating currents as at present used are a constant menace to life and limb, I am sure that some safe way of electrical distribution will be promptly devised, and these companies will not go out of business. The alternating current combination is an immense one and has unlimited capital at its disposal; it can well afford to expend a fortune, if necessary, in experimenting upon safety devices, but it will not do so unless it is forced to do it.

What corporation ever has spent money for the safety of the public until it was forced to do so by legal enactments or by business competition? The greatest life-saving invention of modern times, the air brake, was not adopted voluntarily by the railroads. For years many of their managers insisted that no mechanism could be as reliable as a brakeman with his hand brake. At last they were all forced to yield and the saving of lives and money through the use of the air brake cannot be computed.

The friends of the alternating system have tried to give the impression that I am the only person who is in favor of limiting their voltage, except, of course, their competitors for business. That is a very broad statement, and I will reply by quoting from the English law on this subject: "19. The electricity passing at any time through any line of the undertakers; being in or under the premises of any consumer, shall not exceed 200 volts for incandescent lighting, nor 4,000 volts for lighting by the arc system, or for the transmission of power."

In regard to Germany, I quote from a letter to a prominent insurance man, from the firm of which the Siemens Brothers are the head:

"*Dear Sir:*—Replying to yours of the 24th inst., I beg to state that as far as I am aware there are at present no high tension converter installations in use in Germany; as to England I am unable to speak. Speaking for myself, personally, I am decidedly of the opinion that in Germany the converters would not be permitted inside of the buildings, and further, in my opinion even the secondary wires would be looked upon with suspicion, wherever the converter itself might be placed, in view of great liability of the high tension current to escape to and traverse them.

Yours very truly,

NEW YORK, March 26, 1888. E. KAISER."

The recent French electric lighting act is even more severe. I have not yet received a full copy of the new law but quote from the London *Telegraph Journal and Electrical Review* of July 6, 1888.

"It would appear that so long as a certain voltage (60 volts for alternating and 500 volts for continuous currents) is not exceeded, but little control is exerted over complete installations carried out on one and the same premises, the preliminary formalities, in these cases, being dispensed with. The safety of the workmen is particularly cared for, it being enacted that they are to wear India rubber globes, and on no account to carry bare wires in their hands."

These limits were set in accordance with the recommendations of M. D'Arsonval who has made a study of the danger limit and who was the first to suggest the placing of a voltameter across the terminals of a continuous current dynamo, as a means of protection against the extra current caused by opening the circuit. This gentleman says that one-sixteenth of the pressure used and declared "safe" by the alternating current people in this country, is fatal. We will try to find out this afternoon which of the two is correct.

For the benefit of any who are unfamiliar with electrical units I will say that the volt is the unit of electromotive force (or pressure); the ampere is the unit of current strength and the ohm the unit of resistance. Currents which flow steadily in one direction are called continuous, and those which have an impulse first in one direction, and then in the other, are called alternating.

My first experiment will be with the continuous current, and I have arranged a relay so as to prevent the extra current caused by opening the circuit, from reaching the subject. I have asked A. E. Kennelly, chief electrician of Mr. Edison's private laboratory, to assist me in the management of the current strengths and the reading of the voltmeters, and I would like to have Schuyler S. Wheeler, electrician of the Board of Electrical Control superintend the measurements of the resistances of the subjects, and if Prof. Henry Morton is present, I would be very glad to have him assist in the same and check readings on any of the instruments.

The resistance of a living being will be found rather troublesome to measure, as even the small current used for the purpose will, as soon as it passes through the living tissue, tend to reduce the resistance; especially so if it be alternating. This is one reason why alternating currents are more dangerous since the longer they flow, the less the resistance becomes and the greater is the amount of current received. The tension of the muscles will also still further reduce resistance. I have in the engine room a dynamo made by the Edison company for municipal lighting, and I have arranged these resistance boxes in its field (or charging magnets) circuit so that I can vary the pressure at will from zero to 1,400 or 1,500 volts. I propose to close the circuit upon the subject at gradually increased pressures, and as long as the relay does not fail in making its contact, the animal will not be injured beyond being alarmed and startled by the shock.

We have in the engine room a small alternating current machine, made by Siemens Bros. & Co., of London. We will charge its field by the current from an Edison low tension dynamo, which is ordinarily used for lighting portions of the college buildings. In the field circuit are placed these resistances, so that we can obtain any pressure, from zero to 1,000 or 1,200 volts. This is a converter in the simplest form, composed of a core of iron wire upon which is wound a primary of ten ohms' resistance and a secondary of one hundred and fifty ohms.

The dynamo is run at a speed of 1,080 revolutions per minute, and gives 288 alternations of the current per second. I would like to have a committee of three from the representatives of the alternating current companies, bring up their voltmeters and test the pressures, but I will ask them to record the same and report to me. If any other persons in the room have voltmeters for alternating currents, I should be glad to have them take readings. I shall commence at the pressure which failed to produce fatal results in the last case.

While Dr. Peterson is dissecting the animal, I will take the opportunity of replying briefly to some of the letters from alternating current people, but I shall not notice the personalities with which these letters abound. Personal abuse is out of place in scientific discussions; calling hard names shows how weak are the arguments in favor of high tension alternating currents. The first person to attack me did not have the manliness to use his name, but wrote an anonymous letter which was printed in the *Post* of June 19th. He commences by stating that I am in the employ of the Edison Electric Light company, and bases his attack upon that hypothesis. From 1876 to 1879 I was employed by an early venture of Mr. Edison; for nearly five years thereafter I was connected with the Brush company and located in Chicago; since then I have been interested in an invention of my own which has been tied up by a four years' fight in interference in the Patent office, and have been earning a living as an independent electrical engineer. I have purchased apparatus for clients of mine from the Edison United Manufacturing company, but have never been employed by any Edison electric light interest. Even if I had, it would have no bearing on the matter, but the writer wishes to give the impression that I am not disinterested in the matter, but am acting for selfish motives. This gentleman claims to have taken the full force of an alternating current of 1,000 volts; I have sent him a card in care of the *Post*, and would ask him to step forward and name the voltage that he will dare to take in your presence. He says that railways and steamboats, etc., are dangerous, but that nobody tries to stop them; therefore, his current, which is perfectly safe, should not be reduced in pressure. With all of the dangers of modern civilization except high tension electricity, there is some evidence to the senses to warn people to beware. The moving locomotive, the dangerous bobtail horse car, the insinuating buzz saw, can be seen and heard. Escaping gas can be smelled, over-pressure in steam boilers is shown by the steam gauge; but high tension electricity may lurk in two iron steps, one connected to the circuit and the other grounded; it cannot be detected, or even suspected in many cases until the damage is done. Therefore, the public has a right to insist that every precaution known to science be thrown about its use by law. This unknown refers to a former device of my own for long distance electric lighting, as do several of the others. I will say right here that the device referred to, if used on a high tension dynamo without the protecting device named in the rules recently proposed by me, would be as dangerous as any other part of an arc light circuit, and I have never advocated its use in homes, but only in stores and on the streets where the circuits could be kept out of reach. It was for operating a definite number of incandescents for definite lengths of time, and was not suited or designed for house use. The subject became involved in a patent interference case, and the device was and is withdrawn from sale. I think that T. Carpenter Smith, who makes the same charge against me, was at one time an employe of a company using Brush arc lights and that he then used and sanctioned a similar device of the Brush company for incandescents upon an arc circuit. S. C. Peck, who is I believe, an employe of the Thomson-Houston interests, makes the same charge against me. This gentleman may remember that his company at one time installed a large number of somewhat similar devices, one of which killed a man at Hartford, Conn. M. M. M. Slattery joins in the same cry against me, and he was but a year ago, engaged in manufacturing and selling apparatus exactly similar to one of my devices for the same purpose, with headquarters at Woburn, Mass. Their attacks upon me on that head must have been made upon the supposition that I had a very short memory. But to return to my unknown assailant. He states that the "exploded form of quasi-insulation" (meaning underwriters' wire) "is no longer used." The company at Harlem to which he refers seems to be still using it. He states that "Mr. Brown says there is nothing between the two circuits" (meaning the primary and secondary circuits in the converter) "except a thin layer of cotton or silk; this is true in a sense, but in another sense it is entirely incorrect. There are two layers of cotton or silk on each wire, in addition to which there is usually a layer of other insulating material, and the whole is saturated with a compound of specially high resistance, and the converter is provided with fuses in both the primary and secondary circuits, as an additional protection."

In all our experiments this afternoon, the current has passed through the smallest size of fuses used in practical work, and I wish to ask how much protection they afforded. He further states my fears as to death from the alternating current are "imaginary," and implies that no deaths or serious injuries have ever been caused by the alternating system. Indeed. In this room is a gentleman who was at the Paris Electrical Exposition some years ago, and who sent one of his employes to examine, the day after the accident, the place where two men in climbing a wall near the Grand Opera House, in order to get a better view, touched the two wires leading to alternating current lamps, and were instantly killed. On the czar's yacht, about the same time a man was killed by touching the two wires of an alternating current dynamo. In both of these accidents the pressure or voltage was far less than that advocated for use in this city to-day.

T. Carpenter Smith makes one correction of my article which is true; he says that Mr. Witte was killed by a closed circuit dynamo. My article was written mainly before Mr. Witte's death, and I see that I neglected to change my figures to correspond. For that I wish to be pardoned, as it was an oversight. This Mr. Smith lays all the blame of fatalities upon the condition of the circuits and rates me for not calling attention to them. If he will read my article carefully he will see that I did do so. He quotes the oft-repeated tale of the painter who fell upon the alternating current in Pittsburgh and was uninjured, since the insulation happened to be good, and seems to think that this proves that the currents inside of the insulation could not have been dangerous. To offset this story, which I have no doubt is

perfectly true, I will read a little correspondence which may be of interest.

TRENTON, N. J., July 27, 1888.

"*Dear Sir:*—It was a clear dry day; working on a ladder; cause, pulling an iron wire over primary conductor of an alternating machine; was thrown from a ladder and lighted in a gutter in water and mud, and was severely handled; being alone could not let go of the iron wire. The insulation of the electric light wire was to all appearances perfect. The shock was very severe, and thought the time had come to pass in my checks. Excuse me but I don't care to 'wrassle' with the animal any more. I was laid up for a day or two, and feel the effects of it to-day.

Very respectfully,
E. P. COOPER."

It seems that this insulation is not everywhere as perfect as it is in Pittsburgh. Mr. Smith asks why the Edison company purchased the control of the Zipernowski alternating current system. As I did not know, I called upon Mr. Edison last Friday evening and asked him. He replied that as the Edison Electric Light company was managed by business men, and as the Westinghouse people had made such great claims for the alternating current, they determined to purchase the system. They did so against his protest, paying a very small price for it, but they never put it upon the market. This Mr. Smith states that he has received the full current of a thousand volt machine several times, and it simply makes him feel better apparently. I will ask him to come forward if he wishes to do so, and take a few hundred volts to prove his belief. Let me introduce some more correspondence which will show that Mr. Smith could not possibly have received this current without being at least a cripple. I quote from the *World* of July 14th: "Parkersburg, W. Va., July 13, 1888: Manager J. E. Mayhew of the telephone exchange of this city, was repairing a wire which bad fallen across the wires of the electric light company to-day, when the current was turned on. It caught Mayhew at the top of the pole and shocked him into insensibility. He hung forty feet above the street, jerking to and fro, while his shirt caught fire, and his flesh burned, in view of a crowd of people. His assistant ran up the pole, cut the wire and brought Mayhew down. He was severely burned about the arms and body, and it is feared fatally injured." I at once wrote for particulars and received the following:

PARKERSBURG, July 18, 1888.

"*Dear Sir:*—In reply would say that J. E. Mayhew was burned on Friday the 13th, at 3 P. M., by an incandescent Westinghouse 650 light machine, running at full speed, and a head of eighty pounds of steam and a thousand volt current. There were 650 lamps in circuit, but not more than fifty then burning. The wires are under the telephone wires, and a splice had been left bare and had never been insulated. He was very badly shaken up, his whole nervous system broken up, and his right arm burned to the bone. All the muscles are burned crisp, also the right hand badly burned where he held the wire in his hand. The line he held in his right hand and arm above the elbow laid across the telephone wire and burned it out, also the annunciator on the board. This was done through his arm, so you can judge what sort of a current it was. The time the current struck him he was on top of a thirty-five foot pole and fell across the cross arm, and the wires held up until his assistant at the wires went up and carried him down. His clothing was burned off his arm; he is some better and will probably get well; but his arm will be crippled. I am one of the operators at father's office, and am thirteen years old, and as he could not answer your letter I will try the best I can. Respectfully yours,

CLARA MAYHEW."

A current which passing from this man's hand, up his arm, through his clothing to a telephone wire, which of course was grounded, could burn off the heavy iron wire, and all the receiving apparatus in the office, is not one which can be received with impunity. Had Mr. Mayhew received this current from one hand to the other, it would most probably have killed him. And even this was not the full current from one of their alternating wires to the other; it was simply the leakage from a single alternating current wire to the ground.

S. C. Peck is the next to attack me. He says that the alternating system is perfectly safe because "the primary and secondary coils of the converter are separated by a very substantial septum of insulating material thoroughly dried and shellacked, and finally, the secondary or interior circuit is soundly connected to the earth." This introduces a very decided element of danger. Suppose a well-appointed house, equipped with a telephone and lighted with incandescent apparatus of this kind. A contact between the primary wire and the telephone wire has been made out and the grounds burned off by the primary current as in the case just quoted. The householder wishes to use the telephone and has no means of knowing the dangerous condition of the wires. He turns the bell-crank, but there is no sound; he lifts the telephone from the hook, and turns on his alternating incandescent lamp. As he does so, he touches the yoke of the call box, which is connected to the primary circuit, and touches the socket, which is connected with the ground, and is instantly killed. The electric light company at once says that it must have been heart disease, and if not, it was all the telephone company's fault. Mr. Peck may say that his company's lamp sockets are not connected with the circuit, but are perfectly insulated. But W. L. Wright, under oath says that "The wiring had then been changed and connected to a 1,000 volt alternating current and forgetting that this current would be on the socket, I took hold of the socket while standing on the wet ground, when I received a shock which threw me on my face with my hand underneath me, and still grasping the socket."

Now Mr. Peck says that the house wires are perfectly insulated from the primary or dangerous current, while Mr. Wright says under oath, that he got the 1,000 volt current from the socket. Which is telling the truth? Later in his letter, Mr. Peck, after telling how safe it makes his system to make a permanent ground connection upon the secondary circuit, says that "a constant ground on a high tension dynamo is poor engineering." He thinks that the present practice of testing lines every day is much better. But ground connections are liable to occur at any hour out of the twenty-four, and testing once a day may not find it.

Let me show you how thoroughly most of the station managers test for grounds. They generally have a magneto electric call bell similar to a telephone call; they connect one terminal to the ground, and the other to the line, and turn the crank. If there is no ring, they conclude that the line is perfectly insulated. Now, with this apparatus I can give any person here a painful shock without the slightest ring of the bell, and as in certain conditions the arc current can kill even though it passes through the resistance of a human body, it is evident that a ground sufficient to cause a fatality may exist, and not be detected by this apparatus.

Mr. Peck has also discovered that I am in the employ of the American company, and that my bias in favor of this system is the reason for all my zeal. There are several representatives of that company present, and any one taking that view of the case is referred to them. Possibly Mr. Peck does not remember that there are many other closed circuit armature dynamos besides the American. In his letter he states that there is no self-induction of any moment to produce the dreaded extra current (there he is right) "and opening the circuit" (the alternating current) "and introducing one's self into it merely subjects one to the pressure of 1,000 volts, which has never yet proved fatal. Can Mr. Peck ever read the newspapers? Such statements as that are simply incendiary. What would be thought of a physician who published a statement that arsenic had never been known to produce fatal results, and advised every one to use arsenic for sweetening coffee.

(*To be continued*)

CORRESPONDENCE

New York Notes.

NEW YORK, August 4.—Whatever may have been the motive of Harold P. Brown in calling attention through the columns of the *Evening Post* to the dangers attendant upon electric lighting, he has certainly succeeded in arousing considerable interest in electrical circles, although there is a decided feeling that his demonstration on Monday last was not beneficial to the business. It is generally admitted that there is danger connected with the use of high tension currents, yet dangers are quite effectually guarded against in many other industries, and there is no reason to believe that every precaution will not be taken by electric light managers to reduce the chances of fatal accidents to the minimum without further sensational demonstrations. Another series of experiments has been privately announced by Mr. Brown to take place in the physical laboratory of Columbia College on Friday in the presence of the Board of Health and the Board of Electrical Control or their representatives, also certain electrical people, under a permit which it is said will prevent any interference by the Society for the Prevention of Cruelty to Animals.

Last week C. H. Reed & Co., proprietors of the Hoffman House, made a proposition to Mayor Hewitt, in which they agreed to pay the cost of removing the poles and wires on Twenty-fifth street, if the department of public works would undertake the labor. The mayor says that there are other reasons besides the expense involved, which restrain him from giving the order. He would not feel justified in so doing, he said, if the wires in question were used for carrying out a contract with the city for public lighting, and if they are not so used a complaint to the department of public works would lead to their removal at once. He said that there were legal questions involved in the controversy between the Board of Electrical Control and the electric light companies which should be settled by due process of law. It depended on that board and not upon him, he added, whether the law should be enforced. Papers in the suit had been prepared, but the president of the board had refused to verify the complaint, and the result was that action was delayed. The mayor closes his letter to Messrs. Reed & Co., by saying: "The mayor has no judicial powers, and he would be untrue to his obligations to the citizens of New York if, when important legal questions are raised, he were to proceed with high hand to destroy the property of those who have placed him in office for its care and protection. You, as proprietors of a very large establishment, would be the first to complain if the mayor in the exercise of arbitrary power were to interfere with what you claim to be your legal right, and you will recall the fact that when the mayor was urged to close up your establishment on Sunday as to certain of its functions the mayor took precisely the same course which he is now taking in regard to the electric light companies by recommending that a friendly suit be brought and the matters in dispute be submitted to the prompt judgment of the court. This course was pursued to the eminent satisfaction of yourself, the mayor, and of the citizens generally. All bitter feeling was avoided when the law was vindicated. If the Board of Electrical Control will act as sensibly as you and your associates did in the excise cases a very early solution of the existing controversy will be had and all parties will receive that measure of justice to which, under the law, they are entitled." The appearance of this letter was followed by a formal letter from Secretary Moss in behalf of the board, in which that body consented to assist the corporation counsel in his proceeding in behalf of the city against the United States Illuminating company. The city will not raise the point as to the sufficiency of the subways, but if that issue is injected by the defendant the plaintiff will ask leave to present affidavits by experts to the effect that they are suitable.

At the metal exchange on Tuesday there was but one sale of spot copper, and this was of 25,000 pounds to the syndicate brokers. The price was $16.75, and soon after this sale the same buyers refused to pay more than $16.70, which has set some of the brokers to wondering why the syndicate wants to send the price down, as its ostensible object was to force prices up.

George Westinghouse, C. H. Jackson, and representatives of the Pennsylvania, New York Central, West Shore, and Delaware, Lackawanna and Western railroads were at the Weehawken tunnel on Wednesday to inspect the new system of block signals which is in operation at that point. The signals were also visited by the railroad telegraph superintendents after their recent meeting in this city.

Among other dangers of the streets which have been allowed to become familiar to our citizens, the bobtail cars have, from time to time, received the attention of the press, until finally accidents have become so numerous that the board of aldermen has passed an ordinance to the effect that the Twenty-third street line shall operate no cars on its line unless they be manned both by a conductor and a driver. Similar action will follow regarding other lines, but on account of the difference in franchises no general action can be taken governing all the street railroads.

A bogus telegraph lineman succeeded Wednesday in obtaining admission to the roof of the apartment house 131 East Fifteenth street. He was immediately followed by the janitor, and disappeared through the scuttle of the adjoining house number 133, where in a few moments he succeeded in gathering up about $400 worth of jewelry, with which he escaped. This is another of the evils which will be abated when the wires are underground.

Eliphalet W. Smith of Newark, N. J., who has just completed the installation of an isolated plant for the new county buildings at Pittsburgh, Pa., has gone to St. Louis to erect a plant with 2,200 lamps for the United States Electric Lighting company in the postoffice building in that city. P.

Indianapolis Items.

INDIANAPOLIS, Aug. 4.—Michael Donahue, lineman in the employ of the Brush Electric Light company, was prostrated by heat Monday afternoon while at work, dying in a few minutes.

The Brush company have accepted the contract for furnishing the city lights, as reported last week. They have 185 arc lamps in use now in this city, for which they receive $100 a year each, burning until midnight. The contract with the city calls for $60 per lamp burning all night, for those in the central part of city and $81 per lamp if located in the outskirts. The company are at present running to nearly their full capacity. They expect to be ready in course of the month to begin furnishing lights under the new contract.

The city is being canvassed by J. G. Briggs with a view to locating an electric lighting plant. A large number of subscribers is already assured. Mr. Briggs says no exclusive privileges are asked for. They ask for the use of streets and alleys for stringing wires. If the city council grants them a charter they will begin work immediately. They hope to be ready for operations this season. The company will use the Thomson-Houston system.

The Dudley Electric Railway company were compelled to stop work last Thursday by temporary injunction applied for by the Citizens' Street Railway company, the latter claiming exclusive rights to all streets on which Dudley company were working. The court made the injunction permanent, after hearing arguments on both sides, and ordered the Citizens company to take up all track laid by the electric company, which was immediately done. The Dudley people signified their intention of carrying the case to the Supreme court.

The action of city council and aldermen in relation to the electric light matter does not please the majority of the citizens and in two or three of the wards meetings have been held at which resolutions were introduced looking to taking two members of board of aldermen, who were very active in interest of gas company, off state ticket, they having been nominated for state senators some time ago. While no direct action has been taken, it shows the feeling among the people.

The Indianapolis letter of July 26th, in speaking of bid-

ders for electric lighting, reads "Jenney company." It should have read Fort Wayne Jenney company. The Jenney Electric company of this city was not a bidder. This correction is made in justice to both companies. The Jenney Electric company of this city did not enter into competition, as they agreed with the Brush company, some time ago, not to compete for business in this city. M.

Kansas City News.

KANSAS CITY, MO., August 2.—Replies have now been received from thirty-three cities regarding telephone rates and telephone service. It is claimed that these statements show that the higher the rate the poorer the service. This, the Kansas people are emphatically declaring is the result of high rates. The telephone people on the other hand, however, assert that rates are governed by the size of the city, and that the bigger the city the higher the rates, and the bigger the city the poorer the service; the one, a necessity, the other, inevitable. The returns show that twenty-three cities have lower rates than Kansas City. The rates are as follows:

CITIES.	RESIDENCES.	OFFICES.
Baltimore	$ 48 to $ 74	$ 60 to $100
Boston	72 to 96	96 to 120
Brooklyn	40 to 96	52 to 120
Buffalo*	— —	— —
Chicago	100	125
Cincinnati	40 to 72	100
Cleveland	60	72
New Orleans	55 to 72	96
New York	75 to 100	150 to 180
Philadelphia	100	120
Pittsburg	75	84 to 100
Washington	48 to 72	60 to 100
Albany	48 to 72	60 to 150
Hartford	40 to 50	40 to 50
St. Paul	48 to 60	60 to 72
Newark, N. J.	60	90
Fort Snelling	36	36
New Bedford	35 to 42	35 to 42
Utica	30 to 36	40 to 48
San Francisco	60	60
Nashville	48	60
Memphis	45	55
Topeka	36	50
Oakland	48	60
Leavenworth	36	50
Los Angeles	48	60
Des Moines	36	48
Chester, Pa.	36	66
Peoria, Ill.	36	60
Quincy, Ill.	36	48
Oswego, N. Y.	40	50
Mobile, Ala.	30 to 50	60 to 64
Dubuque, Ia.	36	48

* System of tollage.

The Western Electric Construction company has the contract for the construction and equipment of the electric light plant of the Pine Bluff, Ark., Water Light company, which will be of 2,500 incandescent and 70 arc light capacity. The Western will do all the inside wiring, establish the pole line and equip the station.

O. C. Steele, the local agent of the Brush company, has recently installed 50 incandescent lights at Quindaro, Kan., the Kansas City, Mo., suburb, where the waterworks reservoir is located; 100 incandescent lights for Abernathy & Co., the furniture manufacturing company; and 60 arc lights for the Little Rock, Ark., Electric Light company. He has also sold electro platers to the Western Newspaper Union of this city for its Dallas, Tex., branch, and to the Empire Electrotyping company of this city. A.

From the Pacific Slope.

LOS ANGELES, CAL., Aug. 2.—Judge O'Melveny decided a novel point in the case of Banning against Banning for a partition of property. The question was whether an acknowledgment by telephone was valid. Said the judge in his decision: "The essential requirements of a perfect acknowledgment of a married woman to an instrument signed by her as a party under our law are that the officer, authorized by law to take and certify to the same, shall know her to be the identical person executing the same, and that on an examination of that person without the hearing of her husband, he made her acquainted with the contents of the instrument, and thereupon that he knows she acknowledges to him that she executed the same, and does not wish to retract. The law does not prescribe the mode or manner in which the officer shall acquire this knowledge or by which he shall communicate with her in the discharge of this, his duty on his part, in determining that she does or does not make an acknowledgment. The act is a judicial one on his part. It is not in express terms required that the person shall be visibly before the officer. It is not in this case pretended or urged that there was any mistake of identity of the true person. No one can question or doubt the fact that one who is familiar with the voice of another can distinguish by the voice alone to a moral certainty the individual identity of such person. I entertain no doubt that all facts required to be known, communicated and ascertained, in order to constitute a complete acknowledgment, could be acquired through a telephone, from San Pedro to Wilmington, a distance of three or four miles." The acknowledgment was held to be valid.

HAYWARDS, CAL., July 26.—An electric light plant will be established and in operation here by September 1st.

YUMA, CAL., July 27.—An arc and incandescent electric light plant will be soon installed here. H.

From Missouri Valley, Ia.

MISSOURI VALLEY, IA., August 4.—The Missouri Valley Electric Light company started its plant successfully July 25th. The accumulator system is used and promises the greatest satisfaction to both stockholders and consumers. The current is available at all hours of the day and night, and is utilized for power as well as light. There are now 300 lights and three motors in use. A Fort Wayne Jenney dynamo, sixty-six electric accumulator 15 A cells, Russell engine, and Sawyer-Man lamps constitute the plant. On a recent trial the night run was made on three hundred and ninety pounds of soft coal for twenty-four hours service of current, the engine shutting down at 10:30 P. M., and the accumulators carrying the load at that time until the following evening.

The company has applications for a hundred lights which are yet to be placed, and the capacity of the station is five hundred 16-candle power lights. The plant was installed by the Inter-State Electric company of Kansas City, under the supervision of Paul W. Bossart, general superintendent, and is a credit to all concerned in its installation, its very high economy in running being the great feature to recommend it. V.

Two Alabama Towns.

BIRMINGHAM, ALA., Aug. 2.—T. N. Patee, a local electrician, has published a reply to the article of Mr. Walker in the Philadelphia *Record* of a recent date, denouncing the lightning rods as myths; stating that they were going out of use; that they were dangerous instead of protective, etc. Mr. Patee asserts that one factory in Philadelphia makes as much rod now as was made by all the factories fifteen years ago. So does another firm in Greencastle, Ind. He intimates that Mr. Walker is not cognizant of the great improvements made in lightning rods during the past twenty-five years, and backs up his arguments by references to the records and reports of the Meteorological society, Royal Institute of British Architects, Society of Telegraph Engineers, etc.

The city is having fifteen new lights added to the number now used to illuminate the street.

MONTGOMERY, ALA., July 26.—A telegram has been received from J. Pollak, who is in New York, stating that he had closed the contract with the Westinghouse company for an incandescent electric light plant in this city in addition to the Brush, which Mr. Pollak already operates here. Major Reese telegraphed Mr. Pollak the congratulations of the citizens.

William Wallace, the foreman of the Electric Railway company, who jumped from the third story of the company's building during its destruction by fire a few nights since, and whose leg was broken by the fall and amputated, is progressing very fairly, and there are now strong hopes of his recovery. M.

From Wichita, Kan.

WICHITA, KAN., Aug. 4.—The work of putting in the wires and machinery for the Riverside and Suburban Electric Street railway which is being constructed by the Thomson-Houston Electric company, has begun.

A representative of the Sprague Electric Motor company was here last week and submitted a proposition to the Fairmount Street Railway company to put in two miles of electric railway and equip a number of cars with electric motors. If the two miles can be operated successfully, the line will be greatly extended.

The same representative also submitted a proposition to the Wichita Street Railway company, a horse car line, guaranteeing the operating expenses to be only forty per cent. of those of the horse car line. D.

Denver Doings.

DENVER, COL., Aug. 6.—The Denver Electric Supply company has just started in business, with T. C. Rice as manager. The business of the company is manufacturing specialties for the transmission of power for mining purposes, such as hoisting, hauling and drilling. General electric supplies will be kept, and general electrical construction work done. Mr. Rice, who is a thorough electrician, has invented an electric motor designed for use in mining It weighs ninety pounds, and the one in operation at the works, developed 2,000 horse power at 1,000 revolutions. E.

THE ELECTRIC LIGHT.

An electric light plant is to be put in the custom house at St. Louis at a cost of $25,000.

The councils of Meadville, Pa., are discussing the propriety of adopting the incandescent electric light.

The Western Electric company of Chicago has received an order for a 25-light plant as an addition to plant at Roodhouse, Ill.

The Ft. Wayne Jenney Electric Light company are installing a 250 light incandescent plant for the Lassig Bridge works, North Chicago.

Mt. Vernon, O., has contracted for seventy-eight arc lamps, at a cost of $72 per lamp, per year. The lamps are lighted by the Humphreys schedule.

The Ellensburg, W. T. Electric Light & Power company have ordered an Edison plant for both incandescent and arc lights, and will have it in operation by October 1st.

The Normal Electric Light company of Normal, Ill., has been incorporated with a capital of $25,000. The incorporators are M. T. Burwell, C. L. Gill, H. C. DeMotte, O. Seibert, and Charles DeGarmo.

The Erie Railroad company is trying the experiment of running trains through from Jersey City to Buffalo lighted by electricity. The system is being tested by the Electric Accumulator company, and thus far has been found satisfactory.

The city council of Eau Claire, Wis., has accepted a proposition of the Brush Electric company to light the city for five years at the rate of $110 per light. A higher figure was asked, but competition was threatened, and the above price was made.

During a severe thunderstorm at Wabash, Ind., recently, lightning struck the electric wires and burned out more than half the lamps. The plant had just been accepted from the Heisler Electric Light company. The damage was repaired in a few days.

A lineman in New York in complaining of the bad state of the wires says: "The only way to find out if the wires are dead or alive seems to be to feel them. If you don't receive a shock the wire is dead; if you do receive a shock very likely you are dead."

A communication received at this office says: "The city of Onoka, Minn., has over 7,000 inhabitants and is growing. The water power is good, and is right in the town. There is no electric light company there. Here is a good opening for a live man or company."

Chief Engineer Gereke is arranging to place an electric light engine in the north side waterworks in Chicago. The engine will be run with steam from the waterworks boilers. The light will be used for illuminating the shore inlet and the engine rooms at the waterworks.

"We are working day and night getting ready to light the city by electric light and we are putting every dollar we can get into it," said Prof. Barrett, city electrician of Chicago. "We will be able to operate from the plant a great many more lights than will be seen on the streets this year."

One of the specialties of the Military Geographical Institute in Vienna is the photographic reproduction of maps. In order to avoid the inconvenience resulting from the varying intensity of daylight, the management of the institute have determined to employ the electric light for photographic purposes. Before coming to this decision, the clearness of the light was tested by the Weber photometer.

During the last two weeks the Thomson-Houston company of Chicago, has received orders from the following named places: Alliance, O.; West Bay City, Mich.; Wausau, Wis.; Menominee, Mich.; Marinette, Wis.; Ottawa, Ill.; Helena, Montana; Oakland, Cal.; Los Angeles, Cal.; Quincy, Ill.; San Antonio, Tex.; Memphis, Tenn.; Missoula, Montana; Huntington, Ind. During July the company received orders for 959 arc lights and 4,275 incandescent lamps.

The electric light plant at the gas works is now one of the finest in the country, says a Mansfield, O., paper. Three thirty-five light dynamos of the Western Electric company's pattern are in use, which furnish 102 lamps. There are eighteen miles of wire on three circuits. The company has ordered two dynamos of forty-five lights each, which will be put in place of two now in use. This will give the capacity of the works about 125. Recently the line shaft was taken down from overhead and placed on the floor between the dynamos and engines. This prevents the oil from being thrown about the room and admits of the use of one or two engines as desired without stopping the dynamos or interrupting the currents. A visitor to the works is forcibly impressed with the great cleanliness in the room, and everything is as bright as new. The plant is worth a visit.

The following story illustrates one of the adventures which electric light companies' employes sometimes experience: Mrs. Elizabeth Kinney lives at the corner of Marshall and Slater streets, Paterson, N. J. Yesterday morning men appeared and made preparations to erect an electric light pole in front of her house. She remonstrated with them, and told them that they did not have permission, but they paid no attention to her. Just as the pole was about to be raised Mrs. Kinney came out of her house and calmly stood over the hole that had been dug. "John," she cried, calling to her husband, "bring me a shovel." John did as she told him, and, to the astonishment of the linemen, she began to fill in the hole. After she had thrown in a few shovelfuls, she called her husband. "John," she said, "you fill up the hole and I will pay you for it." She is the owner of the house. John responded and completed the work of filling up the hole. The electric light men then picked up the pole and took it to the other corner, where they planted it. Mrs. Kinney is the heroine of the neighborhood.

THE ELECTRIC MOTOR.

Capitalists in Streator and Bloomington, Ill., are considering the advisability of constructing electric railways.

Frank McGraw was instantly killed by catching hold of the wires of the electric street railway at Lima, Ohio, says a dispatch of last Saturday.

An application has been made to the city authorities at Marion, Ind., for an electric street railway franchise. The cost of the plant proposed will be $45,000.

The North Adams, Mass., Suburban Electric Street Railway company has been incorporated. The company proposes to construct a road from North Adams to Blackinton.

The Thomson-Houston company of Chicago, has installed a 20 horse power motor in the paper-box manufactory of W. C. Ritchie & Co., 154 Michigan avenue, Chicago. All the machinery on the six floors is operated by the motor.

The Enos Electric Systems company has been organized under the laws of Maine by W. C. Otis of Nahant, Mass., W. E. Plummer, Newton, Mass., and others, with a capital stock of $1,000,000 The object of the company is to construct roads on the Enos overhead railway system.

The officers of the Thomson-Houston company are comfortable even in the hottest weather. Ventilating fans whirling at the rate of 2,000 revolutions per minute keep up a stir of air much to the delight of visitors. The motors are run from an arc circuit, and each is one-eighth of a horse power.

The electric railway at Rochester, N. Y., has been completed as far as the Boulevard bridge over the Charlotte branch of the Central railroad. Work is going forward rapidly and it is expected the tracks will be completed before October 1st. The line to Charlotte will not go into operation until spring.

For the electric system it is claimed that it is cheaper, cleaner, more efficient, and more rapid than horses, even on a surface road; while for an elevated road the lighter weight would reduce the cost of construction; any desired speed can be attained; it is safer than steam, and free from cinders, smoke, and the noise of exhaust, says the Chicago *Daily News* The ideal system for Chicago would seem to be a combination of electric motors with the Meigs system of track and equipment for express speed—say thirty miles an hour—and these elevated roads to be supplemented with electric surface roads for way or short-distance traffic.

THE TELEPHONE.

On Sunday, July 22d, the telephone was working for the first time in London on the first day of the week.

The Telephone company has at last recognized the importance of South Omaha, Neb., and is now making arrangements to establish an exchange there.

A petition has been presented to the city council at Council Bluffs, Ia., asking that the whole stretch of Broadway from the Northwestern depot to the new bridge be lighted with electricity.

The "telephone disease" has been discovered by Professor Wilborstadt of Berlin. The use of the instrument produces disorder in the vibratory chambers of the ear, generally in the left ear, he alleges.

The Metropolitan Telephone and Telegraph company of New York, have filed plans for the erection of a seven-story brick and stone front office building, 60x92 feet, at 111–115 West Thirty-eighth street, at a cost of $250,000.

Marshall Bros., machinists of Pittsburg, have brought out an invention by means of which a telephone instrument can be raised or lowered from one floor to another. By means of this invention a single instrument can be made to do duty on any floor of a building.

A dispatch from Fort Wayne, Ind., says: Mr. Wilson, an official of the telephone exchange, arrived here to-day from Chicago to take charge of the office of A. J. Enyard, the local manager, who has been missing since last Saturday. Mr. Wilson says Enyard has money belonging to the company, and they are anxious to get trace of him.

The following description detailing the sensational results of telephoöic experiments, is taken from a dispatch from Cincinnati: Dr. Ernest Weisenbauer, professor of geology in Heidelberg University, is here for a rest after a visit of scientific inspection to the natural gas wells of Findlay, Ohio. He says he found the vastness of the gas well country greatly under estimated. and that underneath the town of Findlay at great depths lay a mighty cavern filled with highly inflammable gas under tremendous pressure. He connected some very delicate telephones with steel rods sunk in the earth through the shaft of the well to a distance far below it. He heard the boiling of the rocks plainly accompanied by cracking sounds. A delicate heat instrument was then connected, and after careful calculations based on its results, he found that at a distance of only one mile beneath the great gas cavity, which lies under Findlay, a fire was raging at a temperature of 3,500 degrees. So astonished was he at this discovery that he was not disposed to believe that it could be so. Again and again he observed, and always with the same results. Not satisfied with making the observation at one point, he took several within a radius of three miles, and his first observations were completely confirmed.

The Pennsylvania Telephone company of Harrisburg, Pa., has brought suit against the Harrisburg Electric Light company for violation of agreement. Some time ago the telephone company had difficulty with the Harrisburg Electric Light company about the latter interfering with the telephone wires, and a suit was brought to compel the electric light company to remove its naked copper wires away from the telephone wires. The suit was settled on a written agreement wherein the electric light company promised to remove its wires from those of the telephone company and take immediate cognizance of any complaints made thereafter. This agreement, the telephone people say, has been repeatedly violated, and the naked copper electric light wires are so close to the telephone line as to prevent the proper repair of the latter. Numerous requests have been made to have them removed, but they are all unnoticed. At the last meeting of the board of telephone company directors, Col. Jordan was instructed to bring suit for a violation of the written agreement whereby the telephone company is damaged, and not only prevented from keeping up its own plant, but also from keeping the fire alarm in perfect condition, as it must do under its contract with the city. "We are liable every day to be burned out and our exchange torn to pieces by these naked wires:" said Col. Jordan; "In York we were damaged to the extent of a thousand dollars by this very thing, and we have brought suit to recover. We must protect ourselves here, or we will have the very same trouble."

THE TELEGRAPH.

There are 961 employes in the main office of the Western Union in New York city.

The Western Union Telegraph company has applied to the city of Buffalo for permission to construct underground conduits in the district in which all wires have been ordered buried. This will probably dispose of the suit which the city brought to compel the company to take down its wires.

A dispatch from Galveston, Tex., dated August 3d, says: At 12:30 P. M. to-day the steamer Parole successfully restored telegraphic communication with Mexico, Central and South America, via Galveston, after a brief interruption caused by the removal of a fault in the submarine cable of the Mexican Telegraph company.

"An expert operator has to write on an average from thirty to forty-five words, and sometimes more, according to the ability of the transmitter at the other end of the wire," said a telegraph operator recently. "If the sender is a first class man he can make it very uncomfortable for the receiving operator by sending so fast that he wont have time to dip his pen in the ink bottle, not if it were buttoned to his bosom. Then in a thunder storm, such as we are having now, the lightning interferes a good deal with the operator's transmitting. The receiving operator, if his ability allows it, can readily get along by guessing, but he has to be very careful or any mistake that he may make will cause his salary to be somewhat diminished at the end of the month, on account of having to pay the cost of the message, or a few hundred dollars more. No, sir, an operator's life is not one of pleasure, as is the general impression. It's one of continual worry and is strictly business."

Personal Paragraphs.

Daniel B. Stedman, of the Thomson-Houston company of Chicago, returned from his eastern trip last Saturday.

S. A. Barton, general manager of the Thomson-Houston company of Chicago, left on an eastern business trip on the 3d instant.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	350	375
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	110	112
Bell of Mo	150	155
Iowa Union	27	28
Missouri and Kansas	70	71

Miscellaneous Notes.

The Hill Electric works have been incorporated at Ludlow, Ky. The capital is $10,000.

An item is going the rounds to the effect that a machine has been invented to make change by electricity, with a saving in cash boys and girls.

A storm of unusual severity and accompanied by vivid lightning visited Chicago August 2d. Lightning struck in eleven places. One fatality was reported. Lightning fired the stables belonging to the Union Stock Yards & Transit company and occasioned a loss of $15,000. The effect at the Central Telephone station was notable. Whenever a charge came over a wire it was communicated to the others and would knock down the three thousand annunciators, producing the same effect that three thousand simultaneous calls would have. A few blocks away the Western Union operators were enjoying an electrical display. There are 504 wires running into the switch board, and the lightning would snap and pop as it jumped from one wire to another. The fire alarm system in the Town of Lake was so affected by the atmospheric electricity that it failed to operate.

At the annual meeting of the London Association of Municipal and Sanitary Engineers, William Webster, F. C. S., read a paper describing the decomposition and purification of sewage by means of electricity. He passed a strong current of electricity through sewage before the meeting, and the solid matter speedily rose to the surface, leaving the fluid apparently bright. He also exhibited a sample of effluent water eight months old, and a specimen of a disinfecting fluid obtained from sewage twelve months before. The chief expense, he stated, was the engine power, and the process could be applied to any existing tanks. Several speakers considered the process likely to be productive of great results, provided it could be economically applied to the treatment of large quantities of sewage, as the analyses submitted showed the effluent water to be absolutely free from suspended matter.

One of the newest, simplest, yet most ingenious forms of an electric call and annunciator has just been patented in the shape of "Factory-Help Call." It is a combination of clock work and electric machinery. The apparatus, which is quite compact, is fastened to the wall in the office, and wires connect with bells in all divisions of the factory. A list of the names of the heads of departments is painted upon a dial, and a pointer is so arranged that it will indicate the name of the person wanted. Surpose Patsy Bolivar is wanted, the pointer is moved to his name, a rubber key at the base of the apparatus is turned, and then the small bells throughout the factory will strike the number of strokes allotted to this particular person, and he will understand that he is wanted at the office immediately.

Electrical Patents.

Issued July 31, 1888.

386,796. Automatic Regulator for Electric Lamps. Reginald Belfield, Great Barrington, Mass.

Claim 6 reads: "The combination, with an electric generator and a circuit for the same, of an induction coil having its primary coil in said circuit, a circuit including the secondary coil, means for varying the resistance of the secondary circuit, a soft iron core and two coils acting upon said core, which coils are included in the secondary circuit."

386,797. Method of Automatic Regulation for Electric Currents. Reginald Belfield, Great Barrington, Mass.

Claim 2. "The hereinbefore described method of supplying currents of any required potential to a work circuit from a source of currents of a different potential, which consists in establishing in the supply circuit a constant counter electromotive force by the action of the impressed electromotive force, and superimposing the impressed electromotive force upon the counter electromotive force, and thereby producing and delivering to the work circuit a resultant composite current having a different potential from that of the impressed electromotive force."

386,814. Art of Telegraphy. Elisha Gray, Highland Park, Ill.

The invention relates to a writing telegraph of that class in which the act of writing the message at the sending station operates to produce it at the receiving station.

First and last claims: "1. The method of transmitting and recording a character by the movements of a transmitting pen and a receiving pen by transmuting the movements of said transmitting pen into pulsations of substantially the same effective strength in an electric circuit varying in number with the linear extent of the movement of said pen and varying in speed of succession with the rapidity of said movement, and transmuting said pulsations through the intervention of an electro motor into movements of the receiving pen.

"6. The method of transmitting and recording a character by the movements of a transmitting pen and a receiving pen in directions opposite of each other by producing in an electric circuit, through the movement of said transmitting pen in said opposite directions, pulsations of substantially the same effective strength and of opposite polarity, respectively varying in number with the linear extents of the movements of said pen in opposite directions and varying in speed of succession with the rapidity of the said movements, and thereby, through the intervention of an electro motor, causing movements of the receiving pen in opposite directions."

386,828. Temperature Regulator. Charles W. Johnson, Holyoke, Mass.

386,860. Coin-Operated Induction Coil. Percy G. Williams and Alfred W. Roovers, Brooklyn, N. Y.

386,886. Multiple Switchboard. Milo G. Kellogg, Hyde Park, Ill.

Claim: "1. In a telephone exchange system, a metallic circuit subscriber's line normally disconnected from the ground at the subscriber's station, in combination with a calling generator in the circuit of said line at the subscriber's station and a switch co-operating with the normally open ground to close the same while the generator is being operated."

386,887. Multiple Switchboard. Milo G. Kellogg, Hyde Park, Ill.

386,898. Secondary Battery. John S. Sellon, The Hall, Sydenham, County of Kent, England.

Claims 1 and 9 follow.

"1. The combination, in a secondary battery, of a frame or support having shelves or projections arranged one above the other, and two or more elements in the form of a dish or tray adapted to hold the electrolyte, independently supported upon the said shelves or projections.

"9. In a secondary battery, the combination of an element consisting of a support to which is applied an active material consisting of an oxide of lead mixed with a porous inert material and an element consisting of a support to which is applied an active material consisting of an oxide of manganese mixed with a porous inert material."

386,919. Coin-operated Electrical Apparatus. Percival Everett, London, England.

386,925. Electrical Non-conductor. Charles T. Lee, Boston, and Charles N. Waite, Medford, Mass.

386,936. System of Electrical Distribution. Marmaduke M. Slattery, Fort Wayne, Ind.

Claim 1: "In a system of electrical distribution and in combination, an alternating current dynamo, and converters electrically connected with the main line conductors in multiple arc and organized to transform the current in the main conductors into currents of less potential and greater quantity in the secondaries, each converter made with a primary coil containing such length of wire exposed to magneto-electric induction that when operated by the dynamo with which it is to be used with its secondary circuit open the electrical pressure and counter pressure in its primary circuit shall be equal, with incandescent lamps or other translating devices in the secondary circuits."

386,956. Regulator for Electric Circuits. Reginald Belfield, Pittsburg, Pa.

The object of the invention is to provide convenient means for turning down any desired lamps or increasing their brilliancy, as required, without causing any material waste or useless consumption of electric current.

We give the 3d claim: "A regulator for electric circuits, consisting of a continuous coil of insulated wire and a core movable with reference thereto, whereby it may be caused to occupy different positions therein without being removed therefrom."

386,965. Telephone Transmitter: William R. Cole, Detroit, Mich.

386,974. Phonograph. Thomas A. Edison, Llewellyn Park, N. J.

386,986. Electric Insulator Peg. William E. Joslin, South Scituate, R. I.

386,992. Galvanometer. Philip Lange, Pittsburg, Pa.

Claim: "A portable electricmeter consisting of the combination of a divided circuit, one branch containing carbon resistances and the other a metallic resistance, an indicating needle operated by the currents traversing the two branches, a containing box having a lid in which the carbon resistances are placed while the metallic resistance is in the other portion of the box, an adjustable resistance in series with said metallic resistance placed in the front of the box, consisting of a coil of wire with a contact movable along its length, and a gauze protection for the carbon resistances."

386,993. Galvanometer. Philip Lange, Pittsburg, Pa.

We give the last claim: "4. In an electric meter, two independent fixed solenoids acting in the same magnetic sense upon a core common to both and movable with reference thereto, one of which solenoids is traversed by a current dependent upon the consumption in the work circuit, and the other by a current approximately constant under all conditions."

387,010. Brush Holder for Electric Machines. Albert Schmid, Allegheny, Pa.

387,013. Electric Converter. Oliver B. Shallenberger, Rochester, and Henry M. Byllesby, Pittsburg, Pa.

387,044. Storm Protector for Electric Lamps. Thomas H. Brady, New Britain, Conn.

387,049. Battery Zinc. Robert L. Carr and Parker Borden, Fall River, Mass.

387,051. Lightning Arrester for Electric Circuits. Frederick A. Cheney Elmira, N. Y.

387,117. Apparatus for Electrical Conversion and Distribution. William Stanley, Jr., Great Barrington, Mass.

Claim: "The hereinbefore described method of equalizing the distribution of potential upon two or more work circuits, which consists, first, in creating a magnetic field common to all the work circuits by establishing in the supply circuit an electromotive force; second, in inducing a counter electromotive force in the supply circuit, and third, in supplying two or more work circuits with composite currents formed by the impressed and counter electromotive force, whereby the excess of energy in one work circuit is transferred to another by means of the magnetic field."

387,123. Flue for Electric Transformers. Elihu Thomson, Lynn, Mass.

387,131. Electric Indicator. William A. Anthony, Manchester, Conn.

"Claim: 3. A stationary helix, an oscillating helix, and a plate which has a peripheral curvature and is attached to said oscillating helix, in combination with a weight and a flexible connection by which said weight is suspended from said plate."

387,145. Galvanic Boiler Cleaning Compound. Francis J Clamer, Philadelphia, Pa.

387,146. Galvanic Boiler Cleaning Compound. Francis J. Clamer, Philadelphia, Pa.

387,160. Electric Rock Drill. George Guntz, Wilkesbarre, Pa

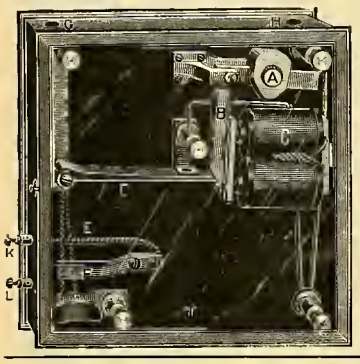
387,167. Explosive Engine. Leopold Julig and Edward Ewald, San Francisco, Cal.

387,194. Regulator for Electric Motors. Addison G. Waterhouse, Hartford, Conn.

"Claim: 1. The herein described method of regulating the speed of an electric motor provided with a closed circuited armature, which consists in diverting a portion of the current transmitted to the motor through a locally closed circuit including one or more of the armature helices, and containing an adjustable resistance."

387,195. Regulation of Electric Motors. Addison G. Waterhouse, Hartford, Conn.

"Claim: 2. In an electric motor, the combination, with the field magnet coils located in the main circuit, of a pair of main collecting brushes, an auxiliary collecting brush, a conductor for connecting one of said main brushes to said auxiliary brush, a conductor for connecting said auxiliary brush to the opposite main brush and around the armature of said motor, and a fixed or adjustable resistance in said last-named conductor."



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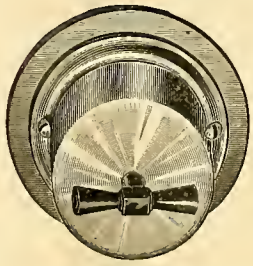

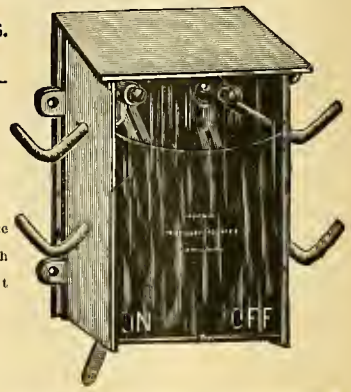

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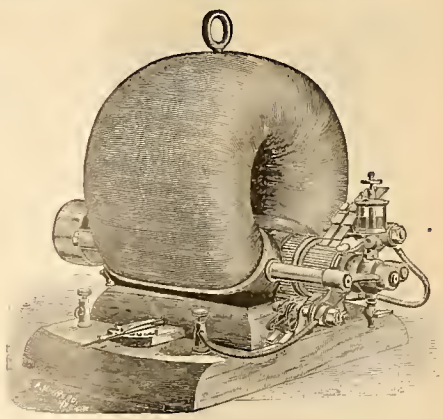

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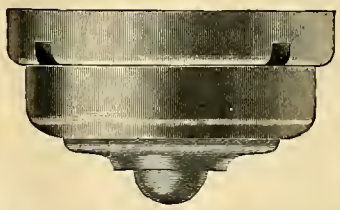

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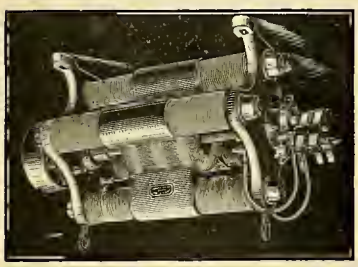

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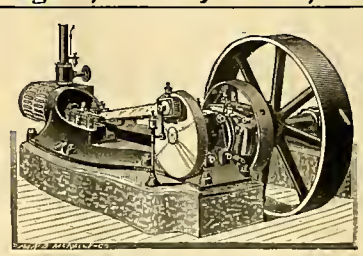

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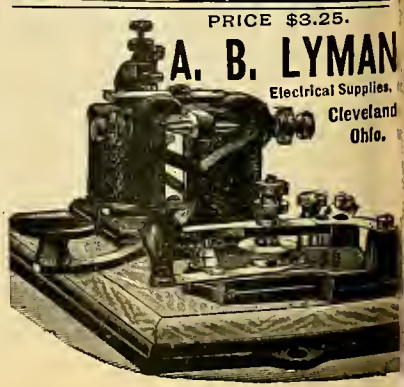

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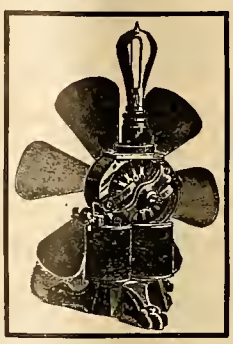

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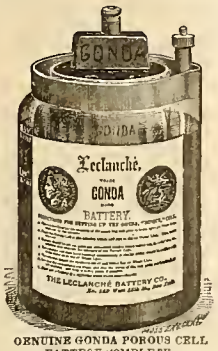

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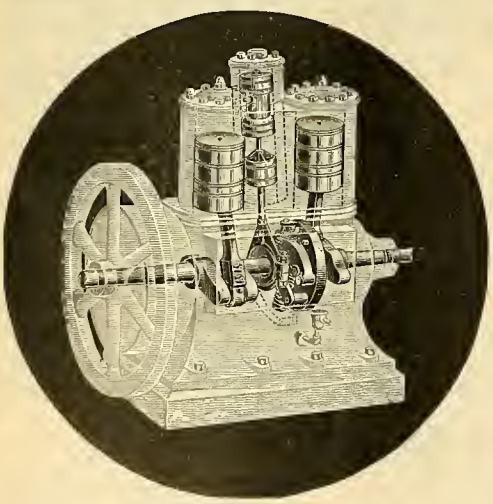

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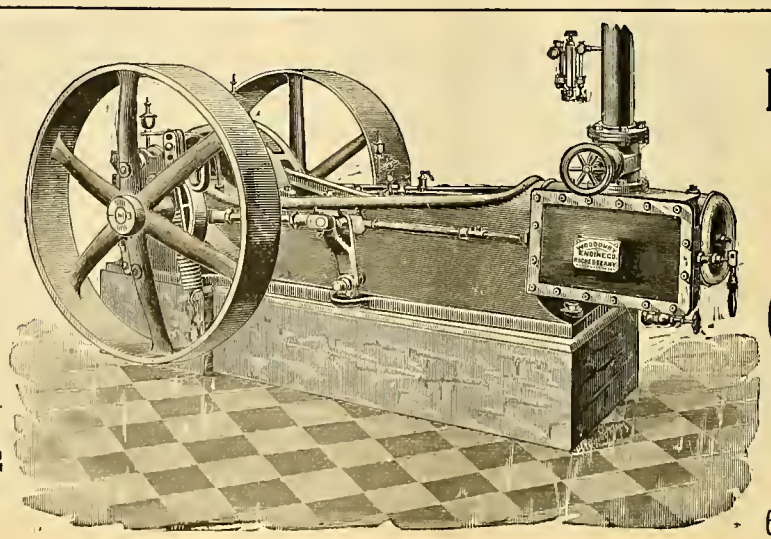

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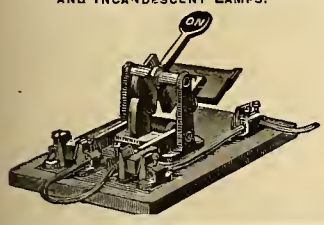

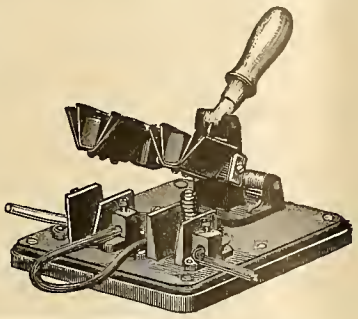

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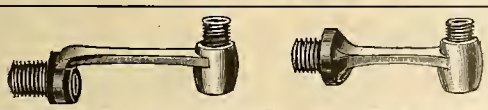

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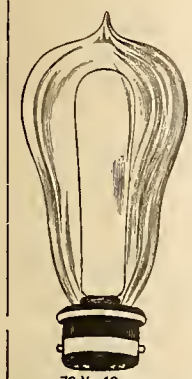

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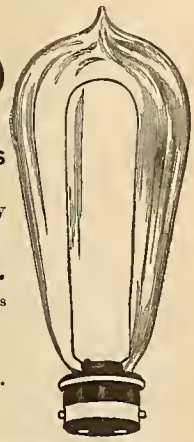

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When through Chicago's alleys passed
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Was reeling off a coil of wire,
Of P. & B.

Miss O'Konite said: "Stay and rest,—
You know our wire is far the best."
But with a smile the lineman said:
"Beg pardon, miss, there's none ahead
Of P. & B."

"Say, chappie, have you tried my wire?"
Spoke young and shy Miss Callender.
"I have, my dear, and I have found,
'Tis much more apt to catch a ground
Than P. & B."

"You'll use my wire?" Miss Simplex cried,—
I'd rather not," he softly sighed,
"For complex troubles often spread
When using Simplex Wire, instead
Of P. & B."

"Gaze on my charms!" Miss Grimshaw sighed.
"No, thanks," he said, "your worth I've tried,
With skin so dark and heart so white.
I found your charms inferior, quite,
To P. & B."

Just then Miss Clark came with a smile
And tried our lineman to beguile.
But he was firm as any rock,
And said: "I'll buy another stock
Of P. & B."

Our lineman onward went and found
Part of his circuit had a ground,
You can imagine his dismay,
When he discovered 'twas "K. K.,"
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The moral of these rhymes is plain,
We need no further to explain,
That when you want a circuit clear,
Buy P. & B., 'tis not so dear
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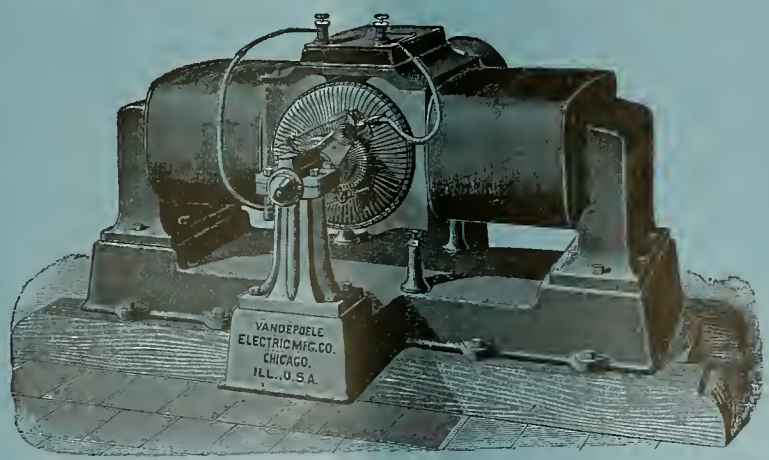

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OF INCANDESCENT LIGHTING,

The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

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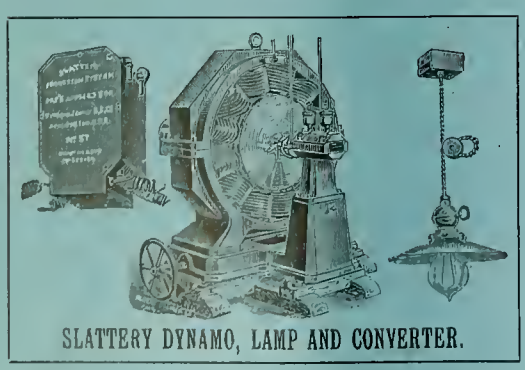
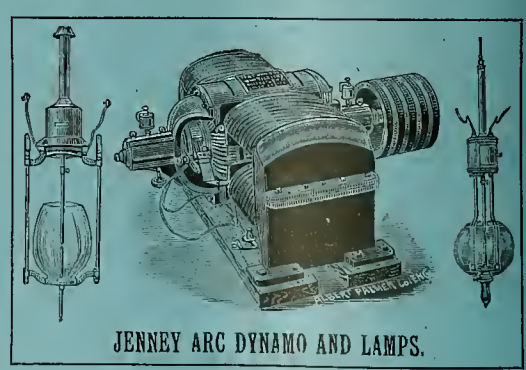


SLATTERY DYNAMO, LAMP AND CONVERTER.

CORRESPONDENCE SOLICITED.



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Main Office and Works, - FORT WAYNE, IND.

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Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol III. CHICAGO, AUGUST 18, 1888. No. 7

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Electric Light Globes, Shades,

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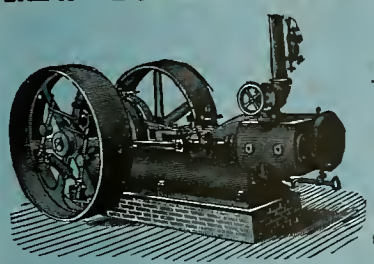

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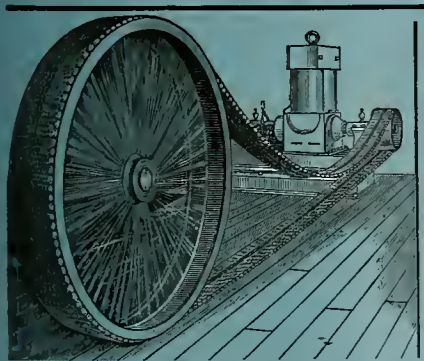

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CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

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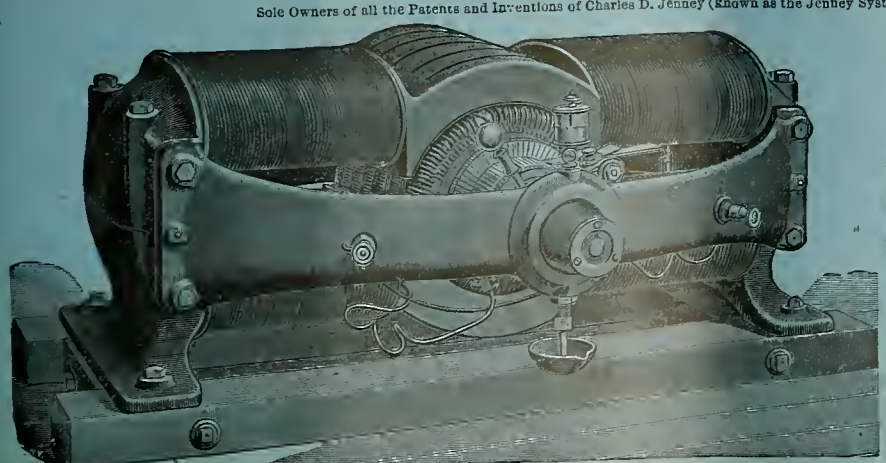
Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

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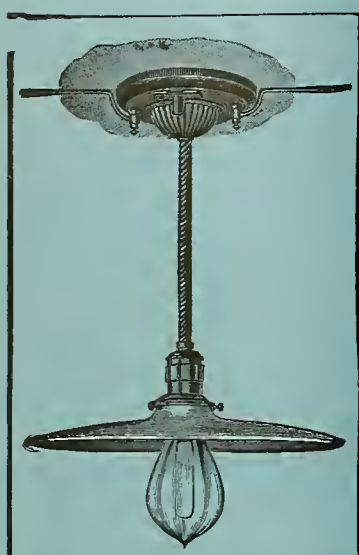

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These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
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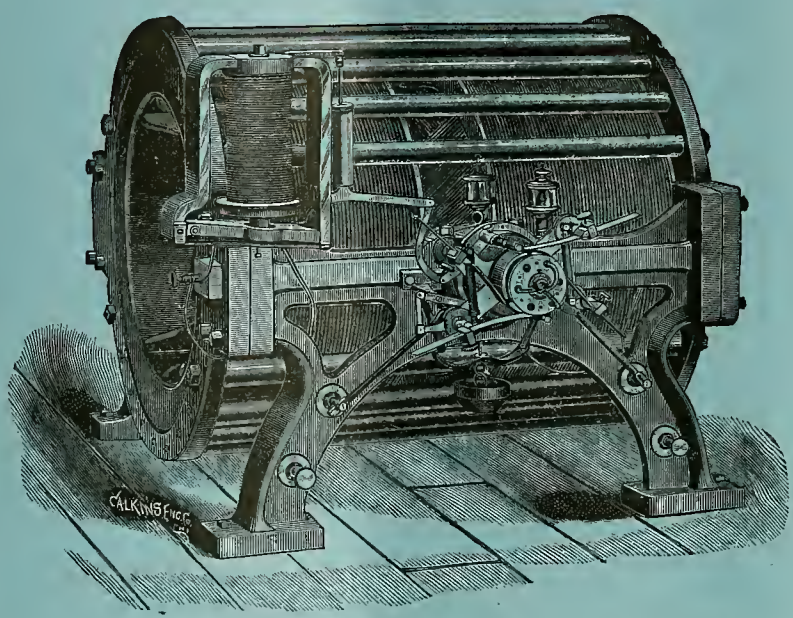

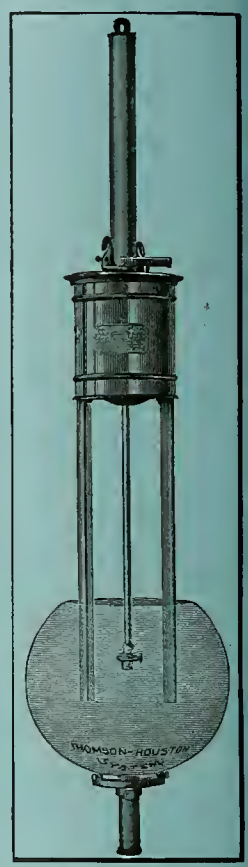

This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

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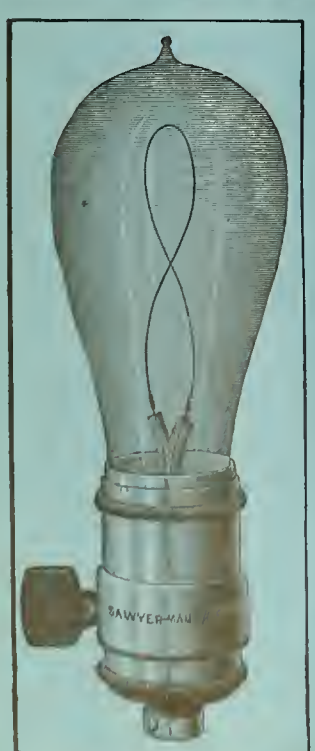
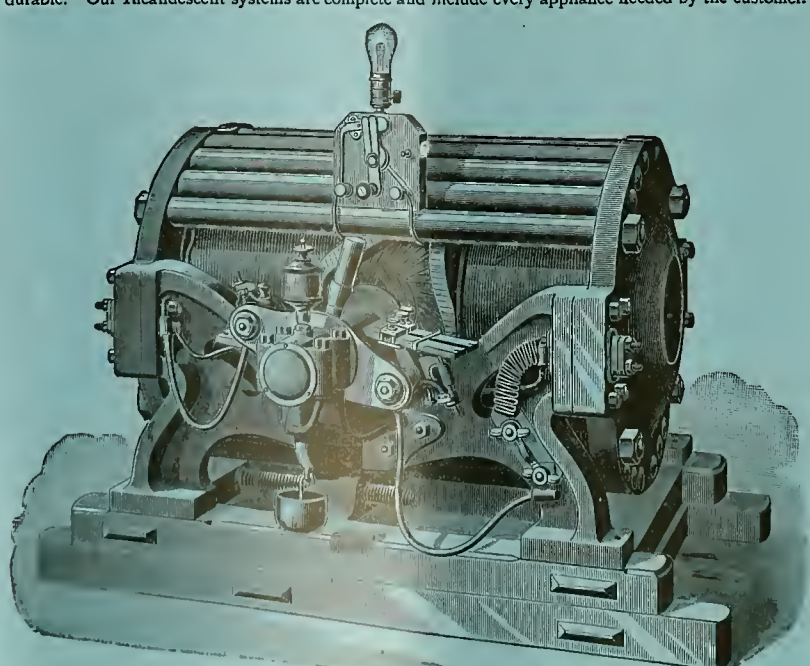
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

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Owing to the Automatic and Self-Regulating features of the DYNAMO MACHINE (tried and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

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Which Patents absolutely control this The Only Permanently Established and Commercially Successful

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As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

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CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

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For information relative to Central Station Business, apply to the

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U. S. LAMP.

GRAND OPERA HOUSE
MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{60}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

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Isolated Lighting, Railroad Car Lighting,
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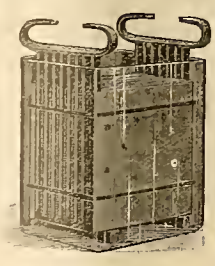

Among the Advantages of this System are:

Absolute Certainty of Light,
Increased Life of Lamps,
Great Economy of Running Expenses,
Absolute Steadiness of Current,
Utilization of Surplus Power,
Adaptability to Existing Plants,
And Complete Displacement of Gas.

Inquiries from NORTHERN ILLINOIS, EASTERN IOWA, WISCONSIN and MINNESOTA should be addressed to the exclusive licensees for said territory,

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MANUFACTURERS OF

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HARRISBURGH, PA.
LAFAYETTE, IND.
WILKESBARRE EXT.
ST. JOSEPH EXT.
WILMINGTON Ext.
SANDUSKY, O.

BOSTON, MASS., West End Railway Co.
DAVENPORT, IOWA.
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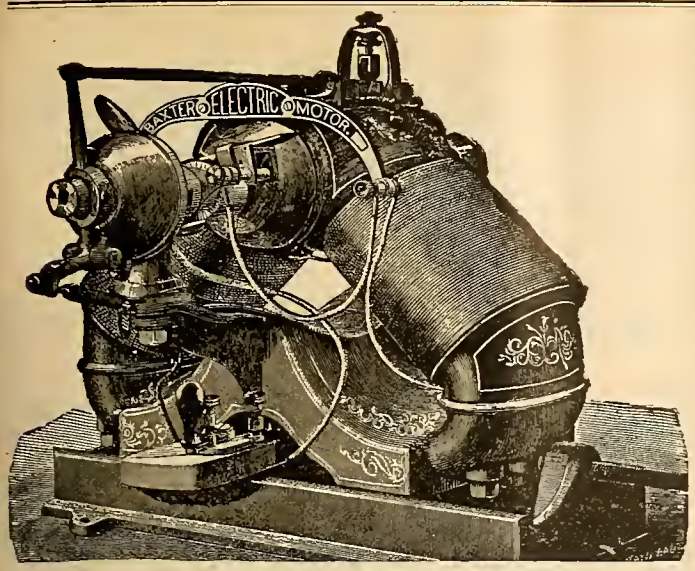
Factory, Corner 13th and Woodbridge Sts.

DETROIT, MICH.



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This Motor is now ready to be placed upon the Market.
Manufactured for both

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Western Department, Dearborn Building, 130 Dearborn St., Rooms 30-31, Chicago, Ill.

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For the Telegraph, Telephone and Electric Light.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learners' Instruments, Medical Batteries, Linemen's Tools, Bell Hangers' Supplies, Railway Velocipedes, Cars, Etc.

Western Agents THE OKONITE CO., and the Return Call System of Hotel Annunciators. Fire Alarms for Cities and Towns. We own the Franchises of the Western States and Territories for the

IMPROVED McCULLOH

→*AMERICAN + DISTRICT + TELEGRAPH + SYSTEM,*←

and are prepared to give franchises and construct plants on reasonable terms.

☞ Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

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Manufacturers and Dealers

IN ALL KINDS OF

ELECTRICAL SUPPLIES.

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Our BELTING is tanned on the surfaces only; the **INTERIOR is RAW HIDE.**

Send for Our Valuable Book for Engineers and Belt Users. Free.

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The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

Use Marks' Compound Wire for Battery Coppers.

High Insulation

In order to meet the constantly increasing demands for

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THE BISHOP GUTTA-PERCHA CO.

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HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

FOR MAKING THE CELEBRATED

HOOPER'S CORE

AND OTHER RUBBER COMPOUNDS

FOR INSULATING WIRES FOR

Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading-in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

HENRY A. REED, Manager.

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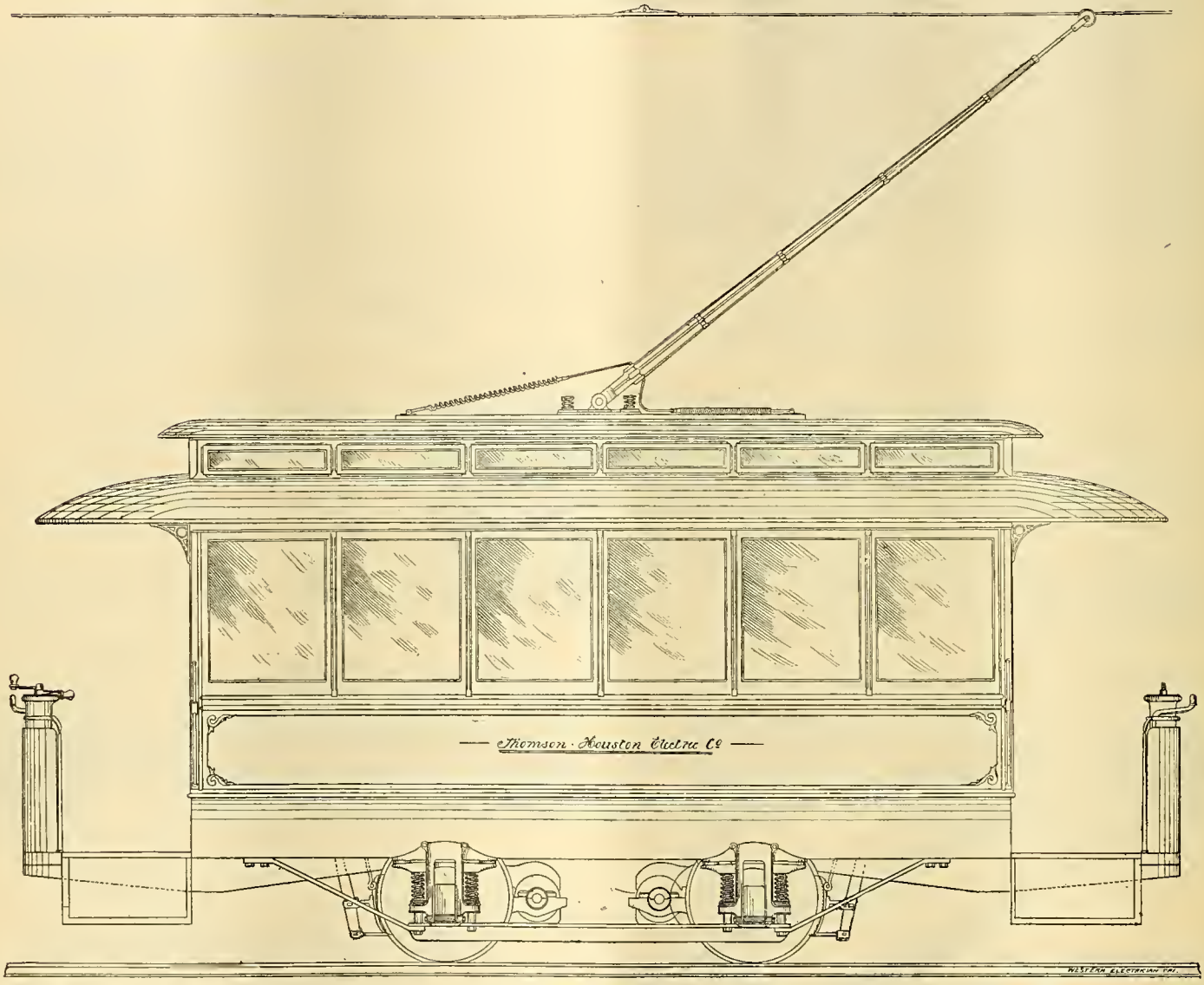
GUTTA-PERCHA FOR SUBMARINE CABLES.

Use Balata Insulation for Flexible Cords.

The Thomson-Houston Electric Railway System.

THE THOMSON-HOUSTON ELECTRIC COMPANY HAS RECENTLY PURCHASED ALL THE VAN DEPOELE ELECTRIC RAILWAY PATENTS.



Sixteen Roads in Daily Operation Under the Thomson-Houston and Van Depoele Patents.

ALL MATERIAL IS NOW MANUFACTURED AT THE **FACTORY** *AT* **LYNN,** *MASS., THE LARGEST AND BEST EQUIPPED ELECTRIC FACTORY IN THE WORLD.*

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Van Depoele patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from bslow.

MOTORS & ELECTRICAL EQUIPMENTS FURNISHED FOR MINING & OTHER SPECIAL WORK.

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THE

WESTINGHOUSE ELECTRIC COMPANY,

PITTSBURGH, PA.,

Manufacturers under Patents controlling the Sale and Use

OF

ALTERNATING CURRENT ELECTRIC LIGHTING APPARATUS.

The installment of over 100 Central Station Plants has demonstrated the Alternating Transformer System to be superior to all others, for distributing current from a Central Station over small or large areas for lighting and power purposes.

ALTERNATING CURRENT METERS.

This system is made more profitable than any other by the use of the meter now supplied by this company.

It measures the whole current.

It is strictly a positive mechanical movement.

It registers directly in lamp hours.

It reads from dials like a gas meter.

It consumes no appreciable energy.

It is not affected by temperature or other local conditions.

It is practical, and it is cheap.

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This company has demonstrated that motors run by the alternating current are as efficient as the best direct current motors, and can be run without commutators or brushes, being started, stopped and reversed without breaking a connection.

All parties desiring to secure the most perfect system of electric distribution for light and power are invited to inspect the apparatus at the works of the company at Pittsburgh, Pa., where it will be demonstrated that the Alternating System possesses such advantages over the direct system in regard to efficiency, distribution, safety, life of lamps, and the use of meters and motors, that no purchaser can afford, at any price, to take the direct current apparatus.

WESTERN ELECTRIC CO.

ELECTRIC ARC LIGHTING APPARATUS.

ELECTRIC BELLS, ANNUNCIATORS, ETC.

PATTERSON CABLES

FOR

Telephone, Telegraph and Electric Light Use.

INSULATED WIRES

OF ALL KINDS.

Testing Apparatus. Telegraph Apparatus. Batteries.

Construction Tools. Line Wire and Supplies.

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The Best of Everything at Bottom Prices

Catalogues Furnished on Application.

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, AUGUST 18, 1888. No. 7.

Firman Pocket Galvanoscope.

The illustration in connection shows the Firman pocket galvanoscope, manufactured by the Western Electric company. This instrument is designed for testing police, fire and district telegraph lines. It is about the size of the cut shown, is of metal handsomely polished, and has a glass face over the needle, which moves between the points marked R and L. At the top are shown the terminals through which connection is made when a line is to be tested.

For convenience in locating troubles on a metallic circuit, it is customary to use the terms right (R) and left (L). Going right means going from any part of the line toward its terminal at right side of the battery, and going left vice versa. In attaching the cords an X marked on the instrument should be placed facing the needle when zinc is the terminal on the right side, and reversely when copper is the right side terminal.

In testing for ground escapes, one side of the split plug, which is marked, is connected with the earth, and the other side is connected with the line. If the line is clear the needle will remain at zero. If it is not, the needle will be deflected to the right or left, according to the location of the ground to the right or left of the testing point. The person testing then proceeds along the line, and when he reaches a point where there is practically no resistance of line between the grounded point and the split plug, the needle will remain at zero. The R and L of wires, which may be readily determined by the galvanoscope, leading to instruments to be connected into a metallic circuit in every case are to be attached to the R and L binding posts of the instruments to insure their being in circuit when grounded each side of a break in the line.

Gray's National Telautograph Co.

Gray's National Telautograph company has been chartered under the laws of the state of Virginia, to do business throughout the United States. Among the incorporators appear the names of the following New York gentlemen: Charles E. Coon, George Hoadley, Joel F. Freeman, Wendell Goodwin, and David I. Carson. It is believed that the main office of the company will be in New York city.

It is a pleasure to state that Professor Gray will secure rich financial returns for the ingenuity, skill and labor he has expended on the telautograph.

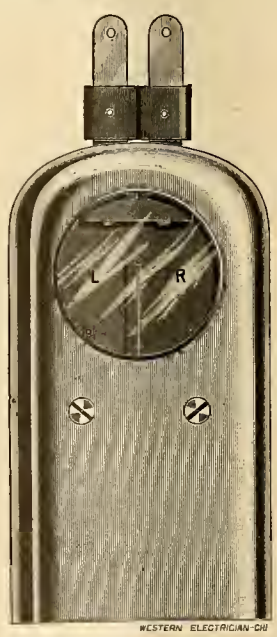
The capital stock of the company is $15,000,000, and it is reported on good authority that Professor Gray will receive $2,000,000 in money and $4,000,000 in stock of the company in return for his telautograph patents. The sum of $100,000 has been placed in the hands of the inventor. In case agreements that have been made are not carried out, this amount is to be forfeited; otherwise, the amount is to be applied as part of the purchase price.

During the preliminary work on the telautograph, in the preparation of the patent specifications, and in the negotiations for the sale of the invention, the professor was exceedingly careful not to say or do anything that would prejudice his invention—evidently mindful of one notable experience.

The Des Moines Electric Road.

The Des Moines Broad Gauge Street Railway company has begun the construction of seven miles of overhead work for an electric road. The road will be equipped with eight cars, each having two motors. The Thomson-Houston electric railway system will be employed. Work on extending the road to ten miles will be begun as soon as the present installation is in operation. Fifteen cars will then be run on the road. It is expected that the cars will be running by September 1st.

There is quite an interesting story of litigation connected with this company. In 1866 an exclusive franchise was granted to the Des Moines Street Railway company which is better known as the Narrow Gauge company, for operating a railway system by horse power. Ten years later the Broad Gauge company obtained a franchise to operate a horse car line. The former company secured an injunction restraining the Broad Gauge company from operating a road on the ground that the first franchise was exclusive. The case went to the Supreme court and in 1877 a decision was reached, which affirmed the exclusive right of the Narrow Gauge company to run cars by animal power. The defeated corporation then determined on the wise course of equipping the road with electric motors. It was thought advisable, however, to determine



definitely whether the company had the right to operate on any condition. Appeal was made to the Supreme court which established that the claim of the company of right to run cars by electricity, was valid.

The franchise of the Narrow Gauge company was changed by the city council, and the new organization was given the exclusive privilege of using electric motors for ten years. With all these points in its favor the company began at once active operations to equip the road at a cost of about $150,000.

Convention of Edison Companies.

The association of Edison Illuminating companies assembled Wednesday, August 8, 1888, at Nantasket hotel, Nantasket Beach, Mass., in their eighth semi-annual convention. The total number of representatives present during the sessions of the convention amounted to sixty members. Several additional gentlemen were present by invitation during certain sessions.

New York city was in every way well represented by E. H. Johnson, J. H. Vail, W. J. Jenks, respectively the president, superintendent, and municipal department manager of the Edison Electric Light company in the metropolis; Electricians Chas. Wirt and H. T. Edgar, and Expert L. Steininger; John I. Beggs, vice-president and general manager of the Edison Illuminating company; C. J. Field, chief inspector Edison United Manufacturing company, and J. W. Schrorder.

From Boston came C. L. Edgar, superintendent of the Edison Illuminating company, S. B. Paine, A. S. Knight, and Hubbard Breed, who is the treasurer of the company with which Mr. Edgar is connected.

Elgin, Ill., sent Chas. Westervelt, the Edison company's general manager.

From far-off Wyoming came R. M. Jones, general manager of the Laramie Electric Lighting company.

From near-by Brockton, Mass., came G. W. Palmer and W. L. Garrison.

Other Massachusetts delegates were Albert F. Dow and J. H. R. Ward of Fall River; C. E. Price, New Bedford, Wm. M. Brock, and G. W. Russell, Lawrence.

General manager A. M. Renshaw, Washington, D. C., was the only registered representative from the capital.

Magnus Pflaum, McKeesport, Pa.; H. Ward Leonard, of Leonard & Izard, Chicago; F. G. King and A. L. Smith, Appleton, Wis.; Jno. R. Markle, C. P. Gilbert, Detroit; Wilson S. Howell, New Brunswick, N. J.; F. E. Jackson, B. F. Card, and F. R. Upton, Harrison, N. J.; President Thomas P. Merritt, and Secretary F. N. Boyer, Reading, Pa.; President Geo. H. Kirchway and Director H. L. Browning, Albany; Manager W. L. Turner and Treasurer F. E. Drake, Columbus, O.; Manager E. H. Brooks, Lebanon, Pa.; Superintendent J. E. Giles, Hazleton, Pa.; Superintendents E. B. Greene, Altoona, Pa., and H. K. McKay, Birmingham, Ala.; Samuel N. Frump, J. A. Lightipe, and F. L. Gilpin, Wilmington, Del.; Manager J. B. G. Roberts, and Superintendent Maurice Hooper, Westchester, Pa.; Secretary H. Brewster, Rochester, N. Y.; Superintendent J. S. O'Brien, Wilkesbarre, Pa. Others at the hotel and present at some of the meetings as delegates or in other capacities were general agent H. McL. Harding of the Sprague Motor company; W. A. Hill, W. H. Atkins, E. L. Caldwell, H. H. Niles, A. O. Shepardson, W. H. Francis, W. D. Marks, Philadelphia, J. R. McLaughlin, Detroit, Chas. Hewitt, Paterson, N. J., T. C. Martin of New York, and W. I. Barker, Boston, both of the *Electrical World*, Secretary F. J. Boynton of Boston; R. F. Ross, *Modern Light and Heat*, Boston; Capt. Brophy, B. F. Simmons, and F. C. Lockwood representing the WESTERN ELECTRICIAN.

The meeting was called to order by the president, John I. Beggs, at 11:30 A. M., and in opening the convention he congratulated the association on the large number of representatives, and the very numerous companies represented.

Some interesting load diagrams showing comparisons of load variations at Columbus, Ohio, were presented by Mr. Turner, manager of that company.

Electric motive power and its widely-increasing application was then discussed.

At the afternoon session of Wednesday, new officers of the association were elected for the ensuing year as follows:

President, John I. Beggs; vice-president, C. P. Gilbert; secretary, J. H. Vail; treasurer, Wilson S. Howell; executive committee, A. L. Smith, F. R. Upton, C. L. Edgar, J. P. Merritt, R. M. Jones.

At the evening session the association and visitors were entertained by a very able and exhaustive paper presented by W. J. Jenks on the subject of lightning and its effect on electric light, telephone and telegraph systems. This paper was splendidly illustrated by numerous stereopticon views. This was followed by a series of stereopticon views exhibited by Mr. Harding, showing the principal features of the Sprague system of electric railways, as well as interesting and novel applications of motive power.

At the opening of the session on Thursday a paper was presented by Mr. Jackson, assistant electrician of the Lamp company, on the subject of the high economy municipal lamp and the result of its application in Edison stations. This was followed by an address by Mr. Upton on a similar subject.

A paper on the subject of feeder equalizers and regulation of electrical pressures on the three-wire system was presented by Charles Wirt. This was followed by another paper by H. Ward Leonard on the subject of proportioning conductors in the system of electric light. Both of these papers were very accurate and to the point, and showed a comprehensive grasp of the different questions involved.

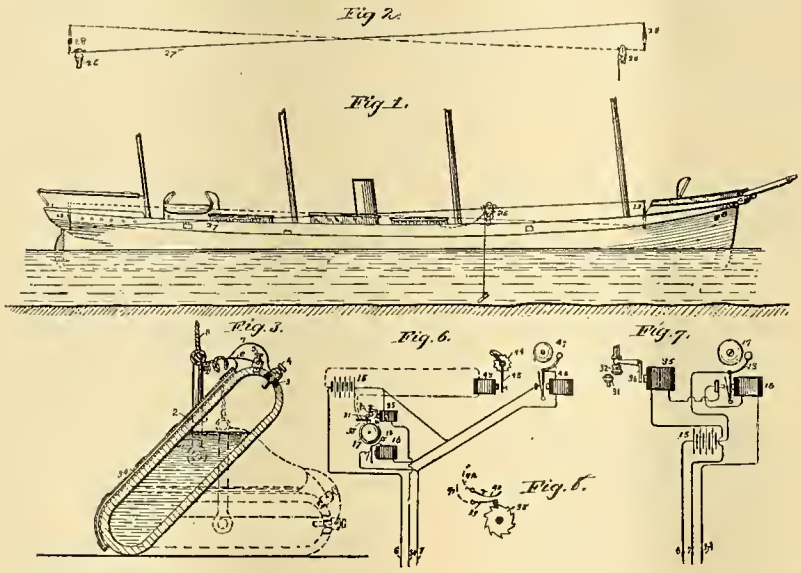
Another interesting report was made by Mr. Jenks on the growth of the Edison municipal system. Mr. Jenks also gave a summary of the work done by the standardizing bureau, of which he is director.

Numerous interesting and valuable discussions were held on the enlarging field for applied electricity, and other subjects of importance to the association.

The executive committee reported that they had selected Kansas City as the best locality for the next meeting of the association. This election was approved, and the convention adjourned to meet in six months at the above place.

Irish's Marine Sounder.

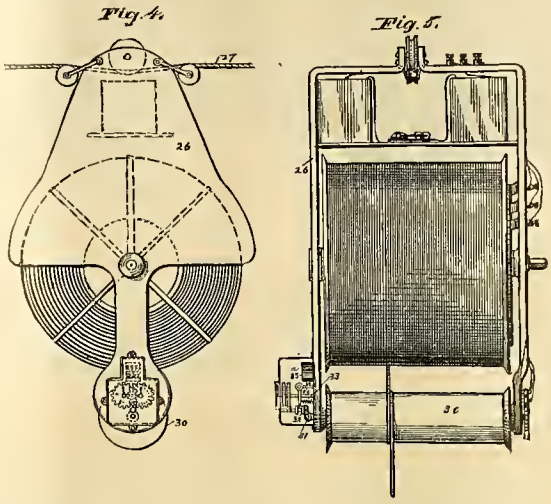
The need of a more prompt and reliable method of taking soundings than the crude methods universally employed must have suggested itself to any one who has watched the operation with lead and line. The ordinary process is merely to throw overboard a heavy weight attached to a measured line, relying on the sense of touch of any one of the crew whose duty it may be to take the soundings. On his judgment depends the safety of the ship, and all on board. The apparatus and system here described have been designed to take the place of this rough, unreliable, unscientific and tedious method, and will be found a valuable adjunct to the equipment of every ship. It consists primarily of a plummet, Fig. 3, which is a hollow metal cylinder containing a quantity of mercury which is confined therein by an insulated screw plug that closes the opening through which the mercury is introduced. The greater specific gravity of the mercury over the lead is no inconsiderable advantage. From the figure it will be seen that one insulated wire is passed through the plug so as to leave the end of the wire exposed within the mercury chamber, but normally out of contact with the mercury. A second wire is simply screwed or metallically connected to the body of the plummet, while a third wire also insulated and specially protected



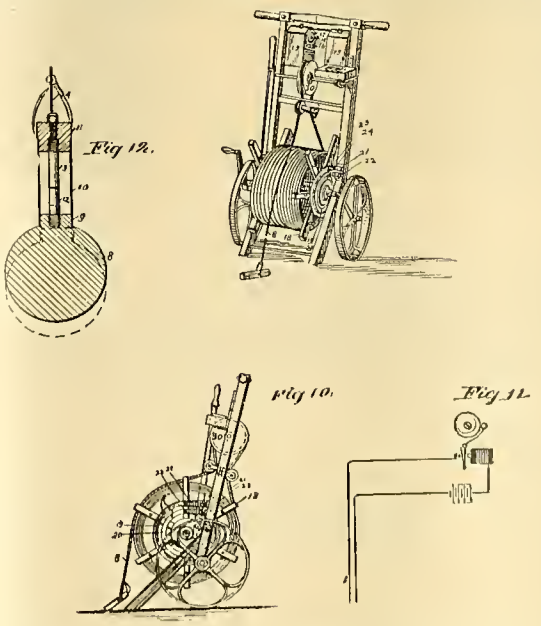
is passed along a longitudinal recess extending to the bottom of plummet, where the end of the wire is left exposed although normally insulated.

These insulated flexible conductors are stranded together so as to form a core in the sounding line, which is wound upon a drum or reel supported on a carriage, Figs. 4 and 5. The inside ends of the wires are connected to commutators on one side of the reel against which springs or brushes carried on the carriage make continuous contact with the wires on the reel, whether the line is being paid out or not. A three-wire flexible conductor is connected from the springs and leads to the captain's bridge, engine room, or elsewhere as desired, where the wires are attached to the recording and alarm devices as shown in Figs. 6 and 7. Figs. 1 and 2 show this reel as running on a cable or wire rope stretched along the ship side, supported on reversible arms. Normally the aft arm is raised while the forward arm is depressed so that the reel and carriage in consequence of this induration of the cable gravitates near the fore arm. The figure represents the fore arm raised while the vessel is in motion and the plummet has just descended and fathomed before the carriage and reel reached midships.

To take a sounding the normal position of the arms are reversed while the carriage and reel run rapidly astern on the inclined cable. At the same time the plummet is released unwinding the line off the reel. The descent of the plummet is accelerated by the travel of the carriage on the cable which helps to revolve the reel and unwind the line so as not to retard the plummet in its downward career by tension of the line or resistance in the revolving of the reel. As soon as the plummet touches the water an electrical circuit is closed through the wire exposed at the lower extremity of the plummet and the wire attached to the plummet and the mechanism of the recording device thereby released. When the plummet reaches the bottom it will by reason of the way it is supported fall on its side allowing the mercury to flow and make contact with the end of the wire passed through the insulated plug, thereby changing the first connections so as to arrest the action of the mechanism of the recording device, at the same time closing a circuit through the alarm and sounding it; thus the exact depth of the water only is recorded and not the length of the line paid out. From this description it will be understood that when a sounding is taken while the ship is in motion the vessel and the carriage with reel travel at about the same speed in opposite directions, thereby permitting the plummet to fall plumb to the bottom within the length of the ship. The line as it leaves the reel is passed over a light running roller, the diameter of which is one-fourth of a fathom.



This roller is caused by simple mechanism, which it is not thought necessary to describe, to record its revolutions on the exposed dials partly shown in Figs. 4, 5 and 9, and on dials placed elsewhere as above described. Figs. 9 and 10 represent a complete portable equipment consisting of plummet, line, conductors, recording and alarm devices, battery, break, hand-barrow reel and wrench, for winding up the line. With this apparatus the actual length of line paid off the reel is recorded, and not the exact depth of the water so that the distance between the water and the reel must be allowed for as in using the lead and line. The simple electric circuit as shown in Fig. 11 remains open until the plummet reaches bottom, when it is closed through the alarm when the mercury in the plummet comes in contact with the wire passed through the insulated plug. As an extra precaution and check against the register the line is marked as usual, and may therefore be employed independent of the register with the advantage that this plummet sinks much more rapidly in consequence of the greater specific gravity of the mercury over the lead.



St. Catherine's Electric Light.

In the issue of the WESTERN ELECTRICIAN of July 28th brief reference was made to the electric light plant in the lighthouse at St. Catherine's Point on the Isle of Wight, which lies in the English Channel, close to the southern coast of England. *The Mechanical News* has reproduced from the London *Engineer* the accompanying cut showing the effect of the light of this remarkable installation.

Prefacing a description of the plant with a few historical points, the account relates that as early as the fourteenth century a priest was established at this place "who should maintain a burning light at night for the safety of mariners," but that at the dissolution of the minor religious houses the light was extinguished and not relighted until 1785, when Trinity house erected a lighthouse on the summit of St. Catherine's downs; this light was found practically useless

on account of the fogs in which it was frequently enveloped. Light from the present structure was exhibited for the first time March 25th, 1840, but the lantern was found to be above fog line, and a few years later the height of the tower was reduced about forty feet, with a marked improvement in the illumination, the light now standing about 134 feet above the sea level at high water. May 1st, 1888, the oil lamp gave way to the electric light, notice having been given previously to mariners that a change would be made on that date to "an electric light showing one flash of about five seconds' duration every half minute," and also announcing that some changes in fog signals would be made.

"Up a steep winding stair a minute later we emerge from the semi-darkness into the bewildering light of the lantern-room," writes the *Engineer's* representative. "Being politely offered a pair of black spectacles, we proceed a few feet higher up an iron ladder to a small gallery surrounding the slowly-revolving polygonal structure of glass by which the light is caught up from the electric lamp within and refracted into the sixteen radial beams, which form the distinguishing feature of this latest achievement of optical science by that eminent firm of lighthouse engineers, Chance Bros., of Birmingham. Through two thicknesses of darkened glass we venture a momentary peep at the central source of light itself — the tiny point no bigger than a marble — where, with a loud hissing sound, a fierce combustion, and the light of 60,000 candles, the electric arc itself bridges the half inch or so of interval which separates the incandescent carbon points. Some idea of the power of this light will be conveyed to the reader when we say that the carbon pencils employed in the electric arc lamps commonly used for street lighting are about three-eighths of an inch in thickness, while those at which we are now painfully gazing have a diameter of sixty mm., or nearly two and one half inches.

"The lamp is of the modified Serrin-Berjot type, and the carbons, which are controlled by a duplex arrangement of spring and current, are not circular in section but fluted, a valuable improvement introduced by Sir James Douglass, whereby the centrality of the arc is greatly promoted, the carbons are kept cooler, and a better supply of air to the lamp afforded. The sixteen-panneled dioptric apparatus is rotated, not by clockwork as usual, but by a tiny vertical engine worked by compressed air from below. As the time of rotation is of the utmost importance, a most ingenious regulator or governor is applied to the little engine, which controls the speed by the automatic application of a brake should the motion become too rapid.

"Entering the engine room, a handsome building to the right of the tower, we see before us a row of three compound engines and boilers, each of 12 nominal horse power, but capable, as we are informed, of working up to 48 horse power should occasion require. The fuel used is gas coke, the residue from the manufacture of coal gas, coal being thus utilized a second time in the production of an illuminant. All the three engines were in steam at the time of our visit, though only one was actually in motion, engaged in driving one of the largest dynamos which generate the electric current. Ready for instant use, with fire banked up and steam at 150 pounds pressure, the second engine stood attached to a duplicate dynamo, only needing the movement of a lever to start into motion, in case of accident to the first set of machinery. The primary duty of the third engine is to compress air for the siren or fog horn. Air compressors are, however, attached to all three engines for use in cases of emergency, and huge reservoirs are constantly kept charged with air at 200 pounds' pressure per square inch, so that the warning note can be sounded at any moment, night or day, when necessity arises.

"The two dynamos were made by De Meritens, of Paris, and if both worked in conjunction, it is computed that the concentrated light from the lantern would equal six millions of candles. The induction arrangement of each machine consists of sixty permanent magnets, and each magnet is made up of eight steel plates. The armature, 2 feet 6 inches in diameter, is composed of five rings with twenty-four bobbins in each, arranged in groups of four in tension and six in quantity.

"Throughout the installation everything is duplicated, and sometimes triplicated, to guard against the possibility of the extinction of the light, even for a moment."

Westinghouse vs. Fort Wayne Jenney.

The Fort Wayne Jenney Electric Light company are feeling quite jubilant over the decision which Judge Colt handed down in Boston the other day. It will be remembered that the Westinghouse company brought suit against the Sun company and M. M. M. Slattery some months ago for infringement. About this time the Fort Wayne Electric Light company became the owners of the Slattery patents and filed a cross-bill asking to be made a party to the suit, and since then the defence has been conducted by the Fort Wayne Jenney Electric Light company, they being the real defendants in the case. Judge Colt has decided the case in favor of the defendants.

The First Electric Flour Mill.

Some months ago mention was made of the fact that at Laramie, Wyoming, the first flouring mill to use electric motors was in operation. The illustrations show an exterior view of the mill, with an Edison station in close proximity, and an interior view showing Sprague motors operating the machinery. The owners of the mill are members of the Laramie Electric Light & Power company, who do the public lighting

for the city. The surplus capacity of the electric light station was such that they used it for operating their flour mill rather than purchase an extra steam plant for the latter establishment.

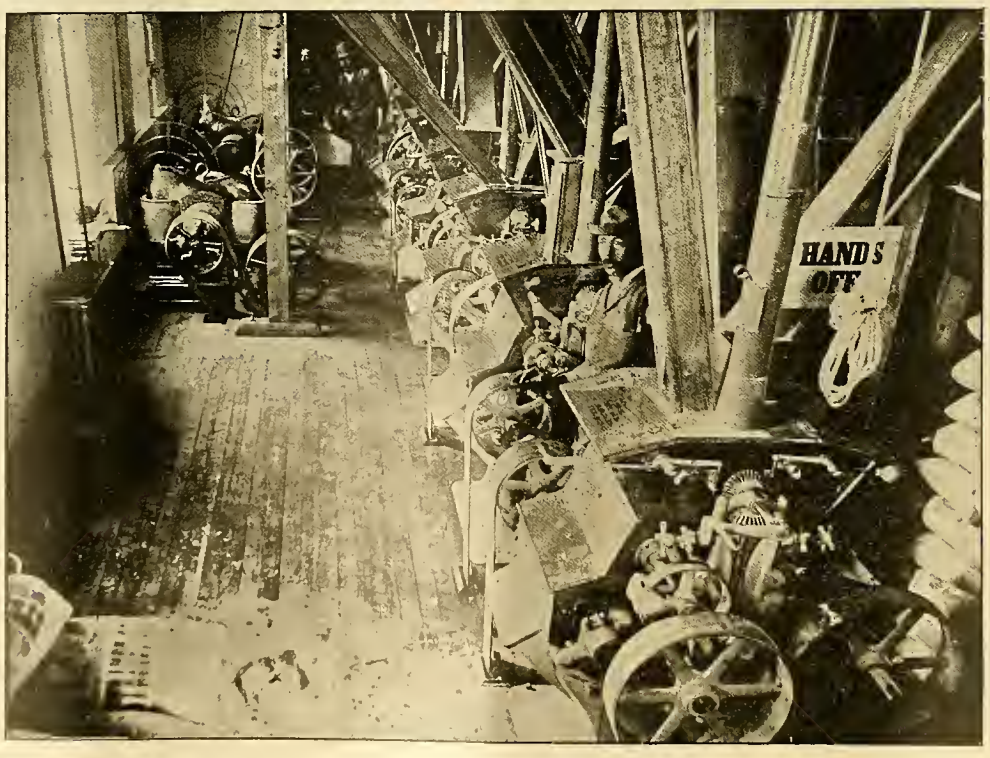
The mill is located about 150 feet from the electric light station. On the first floor of the mill are two Sprague motors, one of which belts to the main shaft in the basement, which drives the rolls, scalpers, bolts and elevators. The other motor belts to a more rapidly running shaft on the next floor, which drives purifiers and cleaners and other machinery.

The motors at full capacity require 226 volts and 150 amperes, and yield 45 horse-power.

The capacity of the mill is about 125 barrels per day. The mill machinery and installed by Nordyke & Marmon Co. of Indianapolis, Ind.

Davenport Electric Railway.

August 12th a trial trip was made of the Sprague system at Davenport, Ia., and was eminently successful. The road is three and one-half miles in length and for 1,300 feet there is an 8 per cent. grade. Six cars were used and they were crowded to their capacity, between 60 and 70 fares being collected on one car alone.



Largest Telephone Exchange.

Editor WESTERN ELECTRICIAN:

BOSTON, Mass., August 10.—No man tries harder than myself to get things right, and I am not in the habit of making inaccurate statistical assertions—least of all regarding the telephone. I am glad, however, that your correspondent in correcting my statement about New York possessing the telephone exchange with the largest number of subscribers, shows that he reads the papers. I appreciate his Homeric compliment. Nevertheless I am right in my statement. It is true that for some months there has been floating around a paragraph that Berlin with its suburbs boasted of 10,000 subscribers. But Potsdam is one of the suburbs of Berlin, and is itself a large city. It would be interesting to know the source of information which your correspondent considers trustworthy. The last published statistics—*Situation des Reseaux Telephoniques* was issued in 1886. The telephonic condition of Germany was then—p. 7—that Berlin had 4,284 telephone subscribers, Hamburg 1,951, Dresden 727, Frankfort 491, and Leipzig 468. At that time the total of *all Germany* amounted to 11,788.

The *Journal Telegraphique* for June, 1888, gives as the total for all Germany, made up to April 1, 1887, 22,078 subscribers' stations, while the *Lumiere Electrique* for February 18, 1888, p. 350, states that in October, 1887, there were in all Germany 22,695 subscribers' stations. But recollect that Germany has 18 cities with a population of over 75,000 inhabitants and that even as far back as October, 1885, these had 7,500 subscribers' stations between them. Under the circumstance then I am satisfied to hold to my original statement, at least until your correspondent shall name his trustworthy informer.

Now a word as to New York. In any case giving Berlin the highest number claimed for it, 10,000, it must be remembered that the suburbs or environs are included. On the same basis, we should be warranted in including Brooklyn, Jersey City and Newark in the population, telephonically speaking of New York. But without these, I hold fast to my original assertion that the New York exchange, and when I say exchange I don't mean central station, but the combined system of central stations and lines which constitute the exchange, has over 7,000 subscribers, and is the largest telephone exchange in the world.

Very respectfully,

THOS. D. LOCKWOOD.

Weems' Electric Express.

Weems' electric express, by which it is proposed to whirl small freight through the country at the rate of ten miles per minute, is illustrated on this page. The Electro Automatic Transit company has been organized in Baltimore as has been noted heretofore, and the corporation intends immediately, it is said, to construct a line from Baltimore to Washington, to demonstrate the practical operation of the system. The cuts illustrate clearly the method of construction. Fig. 1 illustrates first a horizontal view of the car or box; second an end view of a car, and third a side view of the car as it appears on the track. Figs. 2 and 3 illustrate the method of constructing the double and single track systems. It will be noticed that the shuttle carriage runs on two rails with a top rail to hold it down. The overhead rail is also employed as a conductor. Fig. 4 gives a general view of the light construction work as it is proposed to build it. The elevated structure will be about twenty feet above the ground. A permanent generator, of prescribed horse power, is to be located at each end of the line, from which the current will pass to the conducting rail, and will be immediately taken up by the traveling motor, to which one or more cars can be attached. On approaching its destination, it will pass a certain point where the electric current will be cut off, leaving the train to its own momentum which will gradually decrease. Each car then will encounter a trip lever, located at a sufficient distance from the stopping place, which will spring the brakes in succession, bringing the train to a standstill at a designated point. The cost of such a railway is figured out to be the exact sum of $5,079 per mile for a double track, and $3,366 per mile for a single track.

In explanation of the merits of the system the company say in their prospectus: "As a means to the end which we now have in view, and which is the momentous question of this present age of struggle for the mastery over time, the use of electric force is making such strides and attracting such attention in the world of mechanics as to render its general adoption, in all cases where power is necessary, merely a question of time. By the use of this force, intelligently handled, the great desideratum, rapid transit, can readily be obtained, to the fullest extent of its meaning, and with it, the blessings and advantages which must inevitably accompany it. * * * A western journal, a few years ago, with an eye to future possibilities, asked this question: 'Why is not some plan devised to enable banks, moneyed corporations and the public generally to have the advantage of quick transit for commercial paper, securities, money, etc., thereby saving interest, instead of being obliged to await the ordinary modes of uncertain mail delivery?' This question suggested a proposition to a railroad corporation, by a clearing house and a number of merchants in one of the large western cities, offering a handsome bonus, daily, for a train saving only eight hours, which would have saved one day's interest on exchanges, etc., but the road was unable to accommodate them. The use of electric force has been brought to bear upon this particular subject, which will be found not only feasible, but eminently practicable."

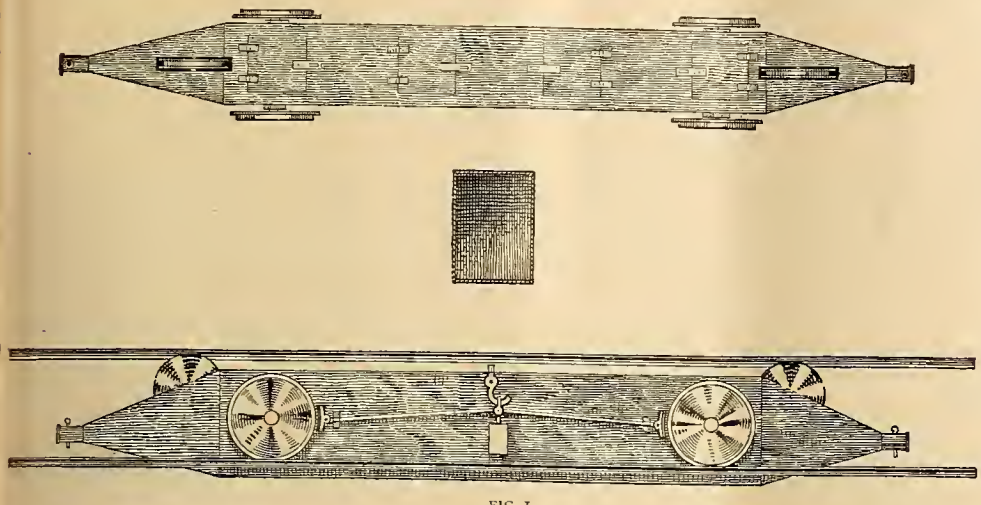
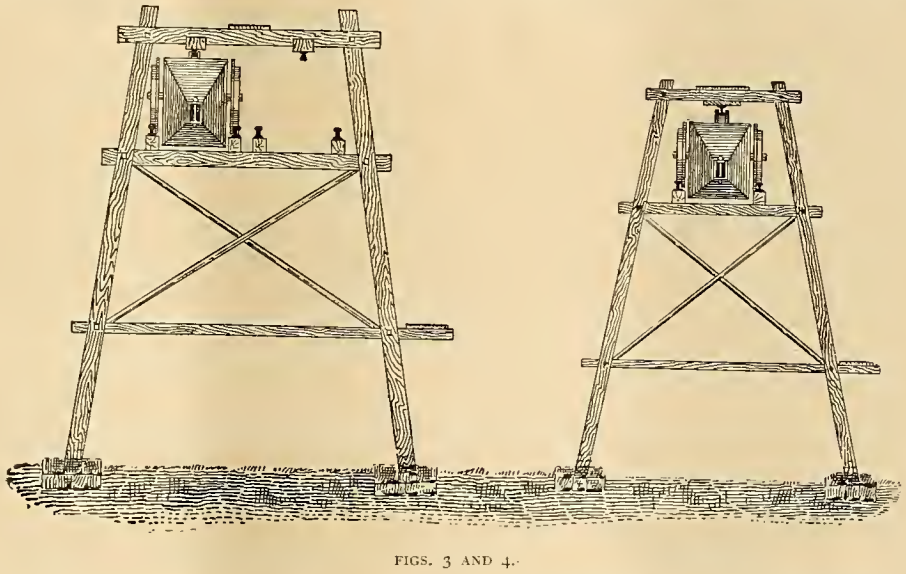


FIG 1.



FIGS. 3 AND 4.

FIG. 4.

The Electric Motor in the Sick Room.

E. S. Pike, a capitalist residing at 2101 Prairie avenue, Chicago, had the misfortune to break his leg about a month ago, and has been confined to his bed since, while the prospects are for a continuous confinement for some time to come. The heat at times has been irksome, necessitating the employment of a person to fan the patient. A short time ago recourse was had to F. N. Armour, agent for the C. & C. Electric Motor company, and he quickly installed a fan outfit consisting of a small fan and electric motor, which is run by two cells of storage battery supplied by the Northwestern Electrical Accumulator company. One charge of the battery suffices for about 50 hours' run. The installation has worked to the entire satisfaction of the patient, those in attendance, and the electrician.

Another "Homeric Nod?"

In a recent issue of the *Review*, the feed water heater of the Hussey Re-Heater and Steam Plant Improvement company, 15 Cortlandt street, New York city, was illustrated and described. The cut was wrongly named, and should have been the Feed Water Heater instead of the "Hussey Re-Heater." There is quite a growing demand among electric and steam plants for the improvements owned by this company.—*New York Electrical Review.*

Are you about to change your title to the *New York Prize Puzzler*, brother editor?

Was not the signal proof of "the measure of the acumen and intelligence" of your readers as evinced by your captivating article, entitled "An Homeric Nod," satisfactory, and a second trial rendered unnecessary?

There are readers of electrical papers uncharitable enough to term your so-called test of the "measure of their acumen and intelligence" an insult to the whole electrical fraternity, and a marked example of insufferable egotism.

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

PAGE

Firman Pocket Galvanoscope, Illustrated 79
Gray's National Telautograph Company 79
The Des Moines Electric Road 79
Convention of Edison Companies 79
Irish Marine Sounder, Illustrated 80
St. Catherine's Electric Light, Illustrated 81
Westinghouse, vs., Fort Wayne Jenney 81
The First Electric Flour Mill, Illustrated 82
Largest Telephone Exchange, Communication by T. D. Lockwood, 82
Weems' Electric Express, Illustrated 83
Another "Homeric Nod?" 83
Electric Motor in the Sick Room 83
Editorial 84
New England Electric Exchange 85
High Tension System before the Board of Electrical Control, Part IV., Concluded 85
Harold P Brown's Reply, Concluded 85, 86
Dr Peterson's Paper 86
The Experiments 86, 87
New York Board of Electrical Control 87

DEPARTMENTS.

Correspondence 87, 88
The Electric Light 88
The Electric Motor 88
The Telegraph 88, 89
Electrical Patents 90

THE eighth semi-annual convention of the Edison Illuminating companies was held August 8th and 9th at Nantasket Beach, Mass. The attendance was large and unusual interest was manifested in the proceedings.

HAROLD P. BROWN, whose name has been brought into some prominence recently, had letters patent issued him August 7th on a system of combined arc and incandescent electric lights, application for which was filed in 1884.

RESIDENTS of Milwaukee will soon be in need of sympathy. A cable line is to be constructed at a cost of a million or more. The projectors would do well to examine the electric system before following in the footsteps of the managers of the Chicago North Side Cable road.

THE REMARKABLE electric light plant in St. Catherine's lighthouse on the Isle of Wight, briefly mentioned in a recent issue, is made the subject of illustration this week. In the immensity, so to speak, of the light lies the chief attraction; as a whole the installation commands admiration.

THE description of the marine sounder, given elsewhere, is one of no little interest. The present method of taking soundings is of such crude character that the only wonder is that it was not discarded long ago for some device which could be depended upon for more reliable service. The invention which Mr. Irish has invented seems to be simple but effective.

SO MUCH has been written of the manifold advantages of the electric motor that it is almost needless to call attention to the special features of the first electric flour mill installation shown on another page. The mill is located 150 feet away from the electric generating station. Two motors only are required to furnish the power and the loss due to friction of shafts is reduced to a minimum, while at the same time the cost of an expensive steam plant has been saved. The plant has been running five months, and its operation has been very satisfactory.

DAVID T. DAY, chief of division of mining statistics and technology of the United States geological survey, has prepared an interesting and valuable report of the mineral resources of the United States for the year 1887. In the summary, the total production of copper is placed at 184,670,524 pounds; the total value, $21,052,440 at an average of 11.4 cents per pound. The estimated total consumption of copper in the United States increased by about 14 per cent.

THE United States senate August 9th, passed the Spooner telegraph bill. The measure prohibits discrimination in rates between connecting telegraph companies and private customers, but does not prohibit the telegraph companies from charging less for press news than for social and business messages. The bill gives to the Inter-State commission the same power and jurisdiction that it exercises over the railroad companies under the inter-state commerce law.

THE controversy between Mr. Lockwood and another correspondent over the largest telephone exchange is growing interesting. Originally, Mr. Lockwood in commenting on a note in the WESTERN ELECTRICIAN, stated that only one exchange had as many as 7,000 subscribers, and that is New York. The other correspondent while paying Mr. Lockwood the compliment of hesitating to contradict or differ with him on subjects telephonic, states nevertheless that there is trustworthy information to the effect that the Berlin exchange operated by the German government has 10,000 subscribers. In the current issue Mr. Lockwood comes to the front again, quotes authorities and holds to his original statement throwing the burden of proof to the contrary upon the other correspondent.

TEN MILES a minute is the speed at which it is proposed to run the Weems electric express. A few years ago the mere statement of such a proposition would have been stamped as an absurdity. Within the last decade or two inventors many times have been laughed at, and their projections demonstrated as utterly impossible by the ablest scientists, and yet in spite of ridicule they have gone quietly ahead, perfecting their work until they have proved that their schemes were useful, simple and perfectly feasible. The public is more cautious nowadays. It has been found best to wait. It is more pleasant to say nothing than to be obliged to make a statement like the following from an English electrical journal in reference to Gaulard and Gibbs: "Finally, we feel sorry that after all they have done, Gaulard and Gibbs cannot hold their patent, especially after the pluck and determination they showed when everybody, ourselves included, ridiculed their scheme." So in reference to the electric express. Ten miles a minute is rather rapid traveling, but no one feels like asserting that it is impossible to attain.

IN a circular that has just been issued by the Johns Hopkins University is the announcement that an electric testing bureau is to be opened from September 1st. The circular, besides the announcement, gives the general methods of measurement that are to be employed. This university is especially fitted for work of this class, for it has an excellent equipment of laboratories, and as well, has established a reputation for exact scientific work.

A number of the largest electrical manufacturing concerns in the country are well equipped with testing apparatus of the most delicate character and employ electricians who have the ability to make accurate and exhaustive determinations, but in the main, these laboratories and the services of these skilled electricians are not open to other workers in electricity who would like to test the value of their inventions either during the progress of their development or after they have been developed. To such, a bureau like that at Johns Hopkins University will be of great service. Similar bureaus have been established in France, Germany, Austria and England, and have met with encouragement.

THE midsummer convention of the National Electric Light association will be held August 29th, 30th and 31st, at the Brunswick hotel, New York city, and as usual, there will be a large attendance.

Chairman Porter of the transportation committee has been unable to secure reduced rates of railroad fare from the Trunk line association, but it is suggested that western delegates can undoubtedly secure low rates to sea-shore watering places or make up a party from Chicago and secure reduced rates in that way.

The headquarters of the WESTERN ELECTRICIAN during the convention will be in parlor 3 of the Brunswick, and a hearty invitation is extended to all delegates to avail themselves of their conveniences.

INASMUCH as the subject of an electric exchange in Chicago, similar to that instituted in Boston, Mass., covering the New England states, has been broached to the Chicago Electric club, and a committee appointed to consider the subject, the full review of the constitution of the eastern exchange and the list of the various licenses issued by the exchange and qualifications on the part of applicants necessary to secure licenses, are in order.

The fundamental idea of the exchange is to secure perfection in installation of electric light and power plants, and the employment of the most competent men for their operation, and this is done by securing the co-operation of the fire underwriters, who will not insure any property where electric light or electric power is used, nor pass any new installations unless the one operating the plant or making the installation has obtained from the exchange a certificate of license.

"WE learn that Hammond & Co. are completing a large plant, on the Lowrie-Hall system, for a central electric lighting station in America," says the London *Electrical Engineer.* "The Americans seem to think, by advices we hear of companies continually introducing their systems here, that we want teaching how to do central station lighting, and that they are just the people to do it. This item looks as if sometimes it was the other way round."

This is really an item of news quite out of the ordinary run and is worthy of insertion in this column. Plenty of proof of the ability of English thought is to be found in American apparatus and we import from Great Britain much of our finer electrical apparatus, sending back in turn American apparatus to England, where in the main it receives courteous treatment at the hands of the electrical fraternity. But a complete central station outfit of English manufacture for America is something quite new and we are interested in the sequel to the announcement.

A BRIEF NOTE in this issue indicates a new field for the storage battery and motor. The note referred to describes an installation of two cells of storage battery and an electric motor in combination with a fan in a sick room, the design being to provide the patient a cooling, refreshing and continuous change of air. The noiselessness of the motor adds much to its adaptability to the place, and to both patient and the electrician the installation has been very satisfactory.

The storage battery has promised much, and the prophecies made in regard to it are now being fulfilled. This installation is of no great importance electrically or commercially, but it clearly demonstrates that there is a large field for temporary installations of the storage battery and these installations can be made to furnish either light or power at will. As time rolls by—not by years or months—but by days, new uses for the storage battery in conjunction with the motor or lamps are discovered, and it seems as though within a very short time electricity will make a wonderful change in the whole social system.

New England Electric Exchange.

At the meeting of the Chicago Electric club July 30th, the newly elected president, S. A. Barton, spoke at length of the advisability of establishing in Chicago an electric exchange similar to the New England Electric exchange at Boston, Mass., and a committee of the club, B. E. Sunny, C. A. Brown, C. D. Shain, J. P. Barrett and F. W. Horne was appointed to consider the matter.

An outline of the objects of the New England Electric exchange was given in No. 22, Vol. II of the WESTERN ELECTRICIAN, published June 2d, 1888, but inasmuch as the matter is assuming greater importance in the west a more extended review of the constitution of the eastern exchange and its methods of accomplishing the objects sought will be of interest.

The eastern exchange is the outcome of various conferences between those engaged in the insurance business and those engaged in the electrical business, at which the matter of diminishing risks to property and life by a more thorough installation of electric light and power plants and the employment of the most competent men for their operation, was discussed. After October 1st next, the fire underwriters will not insure any property where electric light and electric power is used, nor pass any new installations unless the one operating the plant or making the installation has obtained from the exchange a certificate of license.

Article I of the constitution of the New England Electric exchange sets forth its name. Article II states its object to be the general promotion of electrical business, especially in the direction of securing perfection in electric light and power installations and in harmonizing and adjusting as far as possible all differences which may arise between various electrical interests. Article III specifies that any person in the New England states actually engaged in manufacturing, installing or operating commercially an electric light or power plant is eligible to membership and may become a member upon complying with the provisions of the constitution. Article IV specifies the officers. Article V prescribes their duties. Article VI fixes the dates of meetings. Article VII fixes the dues at $3 for each member per year. Article VIII sets forth that all persons who have been pronounced by the board of directors eligible to membership and who have complied with the provisions of the constitution may become members upon signing the constitution. Article IX describes the seal and Article X prescribes the manner in which amendments to the constitution may be made.

The appended defines specifically the classes of licenses and the qualifications the applicant must possess:

LICENSES AND QUALIFICATIONS.

Licenses shall be of five classes, each class representing a certain extent of qualification.

First class licenses shall be issued only to persons fully competent to install and operate any electric light or electric power plant.

Qualifications.—The applicant for a first class license must be able to make working plans for central stations and for isolated installations; must have a general knowledge of the construction of dynamo electric machines and the electrical appliances necessary for electric light and electric power installations; a general knowledge of the principles, construction and installation of secondary or storage batteries; a thorough knowledge of the insurance rules pertaining to the business; a specific knowledge of the systems operated by the applicant, and a thorough knowledge of the calculations necessary for, and the rules governing, electric wiring, and be able to make complete wiring plans. While not a requisite, a general knowledge of steam and water power plants is desirable, and will have due weight with the examiners.

Second class licenses shall be issued only to persons fully competent to install and operate at least two of the following plants, viz: incandescent light, arc light, or power.

Qualifications.—The applicant for a second class license must have a general knowledge of the construction and operation of dynamo electric machines and the electrical appliances pertaining to the particular classes of apparatus it is desired to operate; a thorough knowledge of the insurance rules pertaining to such classes of apparatus; a thorough knowledge of the calculations necessary for, and the rules governing, electric wiring. While not requisite, a general knowledge of steam and water power plants is desirable, and will have due weight with the examiners.

Third class licenses shall be issued only to persons fully competent to make electric light and power installations, and who are not competent to operate electric machinery.

Qualifications.—The applicant for a third-class license must have a thorough knowledge of calculations necessary for, and the rules governing, electric wiring, and the ability to make complete wiring plans; a thorough knowledge of the connecting of electric light and power machinery to the wiring, and a thorough knowledge of the insurance rules governing wiring for electric light and power.

Fourth class licenses shall be issued only to persons competent to install and operate but one of the following plants, viz: incandescent light, arc light, or power

Qualifications.—The applicant for a fourth-class license must have a specific and thorougb knowledge of the installation and operation of the class of apparatus it is desired to install and operate, together with the knowledge and ability necessary to do the wiring pertaining thereto, and a thorough knowledge of the insurance rules governing the class of apparatus to be installed and operated.

Fifth class licenses shall be issued to persons competent only to operate electric machinery, and who are not competent to do electric wiring.

Qualifications.—The applicant for a fifth-class license must have a general knowledge of the operation of the particular electric light or electric power machinery it is desired to operate, and a thorough knowledge of the insurance rules pertaining to such machinery.

(*Where such class of apparatus is not specifically mentioned in the foregoing, "electric machinery" shall be understood to include secondary or storage batteries.*)

Any person desiring a license shall make formal application to the secretary of the exchange, specifying the class of license desired; these applications shall be referred by the secretary to the directors, who shall select three persons to examine the applicant and report upon his qualifications.

The examiners shall appoint for the examination such time and place as may be deemed by them advisable, and the applicant shall appear before them at such time and place for examination.

The examination shall be such as to satisfy the examiners as to the fitness of the applicant for either the license applied for, or for one of another class.

All licenses shall be properly filled out with the class of the license, name and qualification of the licensee certified to by the examiners, submitted to the New England Insurance exchange or to the Boston Fire Underwriters' union, as the case may be, bear in token of their approval the signature of one of their inspectors, and then be dated and issued under the seal of the exchange.

A license shall be valid for one year from its date, but the licensee may apply within that time for examination for a license of a higher class.

The directors of the exchange may, for cause, revoke any license granted by the exchange.

All applications for license must be accompanied by two dollars ($2) to help defray expenses, and must bear the signature of two members of the exchange.

In order to inconvenience applicants for license as little as possible, it may be said in further explanation of the foregoing, that no permanent board of examiners has been appointed, but examiners are to be selected for the different localities, application is made from, and such gentlemen chosen as examiners, as are most familiar with the practical work for which the application for license is made.

High Tension System Before the Board of Electrical Control.

PART IV.

Harold P. Brown's Reply Concluded.

I will quote from the *Daily States*, New Orleans, September 23, 1887: "Several accidents have happened of late to linemen of electric light companies, who have been knocked senseless by coming in contact with the wires while in the performance of their duties. Tuesday last a lineman in the employ of the Edison Light company, pany, was knocked from a pole at the corner of Canal and Carondelet streets by receiving a shock from the wire charged with the alternating high tension current from the Westinghouse machines used by the Brush Electric Light company. The accident was the second serious occurrence in this city from the Westinghouse alternating current. Fortunately, it has not so far turned out to be fatal, as did the accident of a month ago, which occurred as follows: "The unfortunate man who was killed was at work on a pole pulling up a dead arc wire, when his foot slipped and he fell across the wires carrying the alternating current, which wires had been bared of insulation in order to tie them in firmly to the insulators. The man was suspended by the wires, and the current passed through his body from the inside of one thigh to the upper ribs on the other side, the flesh being burned to the bone in both cases. It was probably five minutes before they could switch off the current from him, and by that time he was stone dead. Two serious accidents, one being fatal, from the alternating current in the course of five weeks, render it necessary to call attention to this new element of danger in the streets, and to consider what precautions should be taken. The alternating system is new in this country, and very little experience has been had with it compared with the arc system. However, this experience has shown that this current is quite as dangerous, if not more so, than the arc current, which has killed so many men."

In order to learn whether any more men had been killed in New Orleans since these accidents I telegraphed last week and received this reply from a reliable gentleman: "In September, 1887, a lineman of Brush company at work on lines fell across and was killed, after being burned to the bone. In October telephone employe threw his wire over Westinghouse line and was instantly killed. Cannot get further particulars at the moment."

M. M. M. Slattery repeats the same tale with variations. He says: "After an extended practical experience of three years by those who have carefully followed the alternating system in use, and after many physiological experiments, frequently involuntary ones, to determine the safe limit of pressure to work with, it has been found that no fatality can occur or serious inconvenience result, from a shock from an alternating current having a pressure of that already cited, 1,100 volts."

But soon after he forgets what he has said, and makes this admission: "Now in this case we want to prevent the dangerous current reaching the users of lamps; we know the current is dangerous, practical experience has so informed us." Very well said; it is perfectly safe but we know it is dangerous. This gentleman puts 1,100 volts as the limit that can cause no fatalities. I will quote (how pleasant it would be for the alternating current people if there were no such things as newspapers) from a telegram to the *Herald*, from Buffalo, February 5, 1888: "A fatal electric light accident happened at one this morning. Robert Taylor, driver of the delivery wagon of the Pioneer Co-operative grocery store, was making his way down Michigan street, in the blinding snow and rain storm. At the corner of Eagle his horse dropped, and at the same moment Taylor received a severe electric shock through the lines. He was dazed for a moment, and even after he recovered did not comprehend what had happened. He got down, seized his whip and started to prod the prostrate horse but was knocked down unconscious by the second shock. A colored man, who was standing on the sidewalk came to his relief and attempted to help the horse. He was heard to yell terribly for the space of five seconds and then all was still. Policemen Hennessy and Haley ran up, thinking it was a murder, but in a moment they had the colored man in Smith's drug store pouring whiskey into him. Drs. Hanley and Mulherin came over from the Emergency Hospital on the corner below, and removed the unconscious man with them. As he passed through the hospital door his heart stopped beating and he never knew anything after the current struck him. His hands were terribly burned, the fingers being cut to the bone." He was identified at 2 o'clock as Isaac Morton of La Fayette street, Detroit. The Brush electric light man found that a telephone wire had broken and fallen into the street, making a cross with one of their wires. The wire was found tangled about the horse's feet." And yet Mr. Peck thinks testing for grounds once a day sufficient to prevent any mishap. It does not state in the article what current killed this man, but there is a gentleman present who was told by one of the Brush men at Buffalo that the ground which caused this accident was upon one of the primary wires of an alternating current dynamo, operated at the Brush station.

One of the electrical papers this week states that Mr. Slattery's letter proved that I had opened my mouth and put my foot in it. Here is one of Mr. Slattery's statements that undoubtedly caused me to perform this singular gymnastic feat: "In point of fact the low tension current at 220 volts in underground conductors offers a far greater strain upon insulation than an alternating current at 1,100 volts." Let me contrast this with the statement of Prof. Morton upon the same subject, upon which, by the way, Prof. Morton is high authority: "Even the Edison wires in New York are frequently being torn up to repair injuries due to loss of insulation, notwithstanding their very low electromotive force of but 110 volts, as any one can see who has occasion to go about the streets traversed by the Edison conductors down town. When currents of twenty times this electric pressure, as it has been aptly called, are used, this tendency to rupture the insulation is proportionately increased." Prof. Morton does not quite get my meaning in referring to the galvano-Faradic coil. I desired in a simple way to give the average newspaper reader a slight idea of the effects of pulsations or interruptions, and did not intend to compare this apparatus with an alternating current dynamo. His criticisms upon my Rule 1, I must admit, are well founded. Let us change it so as to read as follows: "Not more than 3,000 volts shall be used upon any arc light circuit."

He is also right in stating that some volume of current is necessary, accompanied by enough electromotive force to carry it through the body, in order to kill, but he is mistaken in assuming that it requires considerable volume. In one of our laboratory experiments (No. 27) a fox hound weighing fifty-six lbs. was killed by a current alternating 288 times per second, at 160 volts. His resistance was 27,500 ohms and the calculated current would therefore be exceedingly small. We found however, that when we used continuous currents and could measure the amperes that produced fatal results, the indicated current was much larger than the calculated current, showing that the resistance had been reduced by the current itself. We had no ammeter for alternating currents and could therefore make no observations, but from our experience in the dropping of the resistance when we reversed the galvanometer current in measuring resistance of living beings, I could assume that the actual current would be at least three or four times as large as the computed current.

Mr Shallenberger has discovered an electric current that does not decompose an electrolyte. He says, "There is a very convincing reason for the small danger due to alternating shocks to the human body as compared to those received from the direct current, namely the fact that the conducting fluids are more or less decomposed or electrolyzed by the passage of the direct current, while it is well understood that such an effect is not produced by the alternating."

Mr. Shallenberger is respectfully referred to the London *Telegraph Journal and Electrical Review* of the 6th inst., where he will find an article upon "Electrolysis by the Alternating Currents of Dynamo Machines," which he can read to great profit. If he will connect a voltameter to his alternating current machine, having very fine platinum wires for electrodes, he will observe an exceedingly brisk decomposition of the electrolyte, producing the gases in a dangerous mixture of oxygen and hydrogen at each pole. I do not think he can cite a case in which death has been caused by electrolysis from a direct current dynamo. Mr. Shallenberger also has received 1,000 volts without injury and ends his article by stating that the alternating system (Westinghouse) is "absolutely safe" both to life and property.

If these people would but say to the public, "Our system is extremely dangerous; you must handle with great caution; we take every possible precaution to protect you but you must not be reckless," one could forgive much. But when they set it up as absolutely safe and instruct their agents and engineers to tell the public so, it is time for them to receive a sharp lesson. It is a common thing for engineers in charge of alternating current stations to say when visitors ask whether the current is not dangerous, "O no, I can put my hands on both brushes." Then to illustrate he puts both his hands on both brushes—of the little dynamo used to excite the fields of the alternating current machine and having a continuous current of a very low voltage. This story has come to me from several different gentlemen who have seen the thing done; there are two of them here this afternoon. But if the visitor pretends that he is going to put his hands on the brushes of the alternating dynamo, the attendant nearly breaks his neck in his endeavors to keep him away. Perhaps this is the 1,000 volt current that so many of these gentlemen have taken so often without injury.

Mr. Byllesby is candid enough to admit that 1,000 volts may prove fatal, and I congratulate him upon his honesty. The advocate of "The Safety Electric Light & Power company" should be required to change the name of this company before it is given permission to operate in this city, or to reduce the potential to a voltage which this afternoon's experiments have proved to be safe.

S. G. Smith is an advocate of the safety involved in testing circuits occasionally with (I presume) the usual

magneto call bell. He is right in stating that a ground connection even though high resistance, would be a strain upon the insulation, but it would not be one-hundredth part of the strain caused by a telephone wire dropping upon the circuit during the night's run.

This gentleman thinks that there is no occasion for the fifth rule suggested by me. Does he not remember that in the same issue of the *World* which told of Mr. Murray's death was the report of the death of a young man at the park in Syracuse, if I remember rightly, who saw the electric wire break and then sparkle upon the ground? He picked it up and was killed.

I cannot close without a reference to the absurd affidavit of W. L. Wright, who solemnly swears that he feels sure that, "if he had received this kind of a shock from a direct current machine of any of the ordinary types, that it would have been fatal."

If we are to believe all the other advocates of alternating currents, it is simply impossible for the 1,000 volt current to have been on that socket. The truth probably is, that he received a slight leakage to the ground from the secondary. But if it is really true that all these men have taken 1,000 volts alternating current without injury, investigation will probably show that they all wear lightning rods.

Gentlemen, I have shown you this afternoon that alternating currents are fatal at 330 volts pressure, and that their use in this country has caused many deaths. I ask you to consider this fa ct: That all these accidents have occurred while the insulation of the circuits was new and in good order. Every element is constantly at work destroying that insulation, and sooner or later it will give way. Variations of temperature strain it as the wires expand and contract; the rain and sleet gradually work their way through; mechanical abrasion by the swinging of the wires in the wind cuts down to the metal and brings death nearer to some unsuspecting mortal. And each succeeding year will show a larger number of deaths from electricity. Therefore I ask you, if you would not care to have this death-dealing converter in your own home, to use all your influence to keep the high tension alternating currents out of the homes of others and confined to its proper work in the slaughter house, the dog pound and the penitentiary.

Referring to my article, I call your attention to the fact that my statement as to the causes of all the deaths from arc light wires has not been questioned.

I have proved by my experiments that a steady, continuous current can be withstood without injury even at very high potentials; that breaking or alternating the current will produce death at a much lower pressure; that the more rapid the alternations the lower the pressure required to kill. These demonstrations cause all the voluminous objections of my assailants to lose all weight. I have shown that a continuous current will not kill if an apparatus is provided to receive the extra current. I think I am, therefore, justified in asking this honorable board to adopt rules 1, 2, 3, and 6 and leave the others until I can prove upon arc light apparatus that they are practical and effective.

Let us consider what hardship, if any, is involved by the adoption of rule 6 limiting the voltage of alternating currents to 300 volts. It means simply this: That the alternating current companies will have to put in mains having $3\frac{1}{3}$ times as much copper as that required with their present voltage. They now say that the cost of their mains is inconsiderable; very well; force then to multiply the cost by $3\frac{1}{3}$ and it will not ruin them. At the same time the insulation resistance can be reduced in the same proportion, which will effect a saving in first cost and in leakage.

What is gained by forcing this wealthy corporation to buy a few thousand pounds more copper? Safety from sudden death!

Doctor Petersons Paper.

Dr. Peterson had been associated with Mr. Brown in making a series of experiments on dogs read a paper which dealt with the results of electricity on animals. The doctor said:

On the persons of human beings lightning often strips off, tears or burns clothing, oxydizes or melts buttons and watch chains and renders knives magnetic. It may burn the skin and hair, lacerate and perforate the body, fracture bones (Taylor), cause extravations of blood everywhere in the body, such as apoplexies of the brain or meningeal hemorrhages, amputate a limb (Sycanko, Berl. Klin. Woch, 1868), or cover the body with curious hyperæmic arborescent marks. Some die from the injuries received, only after the lapse of considerable periods of time, as from tetanus (Taylor), or hemillegia in a month (Bugge). Of perhaps a third struck by lightning who live, most are subject to nervous diseases in various forms. They may be unconscious for hours or days, become delirious, even maniacal, have all sorts of paralyses and losses of sensation, be affected with blindness or deafness, or have convulsions, epilepsy or neuralgia. Hensner relates how a thunder bolt struck twenty people, killed four, burned or lacerated the clothing and skin of the rest, and in many made peculiar openings in the soles of the feet as it passed through their bodies into the ground.

The changes to be found on making a post mortem examination are almost wholly coarse lesions visible to the naked eye, such as laceration of the brain or other organs. Rigor mortis is said to appear early, and often there is a cataleptic rigor mortis at the moment of being struck, so that persons are found dead in precisely the attitudes last assumed when living. The blood is dark, and unusually fluid.

The doctor spoke of the experiments of Dr. Richardson and Prof. Nathnagel with discharges from Leyden jars and frictional apparatus on sheep rabbits. Electricity in medicine was next referred to, after which Dr. Peterson spoke of his own experiments as follows:

I am willing to demonstrate on any one here present that alternating current shocks are more powerful and severe than a continuous current on its mere interruption. As a current will stimulate a nerve in something like 15-1000ths of a second, it is clear that when the continuous current is closed upon a body for any limited space of time, there is but one shock at the closing and one at the opening of the circuit; where, as with an alternating current for the same interval of time, the shocks are twice as strong, and as many in number as there are reversals of the current per second. If the stimuli are too numerous, say over 65 per second, a condition of tetanus is produced in the muscles supplied by the nerves stimulated. The same fact holds good as to the currents of any strength. From this it must appear plain that if a continuous current of say 1,600 volts e. m. f. is sufficient to cause death, then an alternating current of much less than half that voltage must be fatal under the same conditions. This is well illustrated in the experiments recently undertaken. Dog No. 5, weighing 50 lbs., took in succession continuous currents of 1,100, 1,200, 1,300, 1,400 and 1,420 volts, the last the highest voltage at command, and a few minutes later 1,200 volts for two seconds and unhurt by any, skipping about as well as ever when released. Dog No. 6, weighing 55 lbs., was given a 300 volt current alternating 4,100 times a minute for two seconds, which caused him to howl and struggle, bite his tongue and bleed at the mouth, then another of 400 volts for two seconds, then a shock of 500, and finally a 580 volts of alternating current for three seconds, which killed him. During the latter three shocks the dog was silent and motionless. In dog No. 3, weighing $13\frac{1}{2}$ lbs., 100 volts continuous current was fatal, while dog No. 4, weighing more than three times as much, and with 5,000 ohms more resistance than No. 3, was killed by a current alternating 2,200 times per minute. The shocks by the alternating current caused more exhibition of pain as manifested by greater howling and struggling after opening the circuit, than did those of the continuous current. But the more numerous the alternations per second the greater the number of powerful stimulations, and hence the more serious injury.

Dog No. 2 died from an 800 volt current alternating 1,600 times per minute applied for three seconds. He consequently received more than 26 voltaic alternatives per second, or altogether, about 80 voltaic alternatives. Dog No. 5 died from an 800 volt current alternating 2,200 times per minute, applied for two and one-half seconds, or 91 in all. I am sure a smaller voltage would have killed that dog. Now, since each alternation of the current gives twice as great a shock as an interruption of the current, it follows that the more numerous the alternations of a powerful current the more decided will be its effect. Consequently by increasing the number of alternations per second, we should expect a smaller voltage to be fatal. This is exemplified in the case of dog No. 6, killed by but 570 volts, the number of alternations having been increased to a little over 63 per second, the duration of contact being three seconds. This dog therefore received 195 voltaic alternatives. When, with dog No. 7 the e. m. f. was reduced to only 250 volts, while the number of alternations was increased to 288 per second, a contact of five seconds killed him at once. Dog No. 8 was killed with but 160 volts e. m. f., administered for five seconds, with 288 voltaic alternatives per second.

It is in fact startling to see how small a quantity of e. m. f. is required, provided the alternations of the current be multiplied. In each dog the current was passed from the left hind leg to the right fore leg.

Dr. Peterson then gave, somewhat in detail, the result of the autopsies, describing the effects of the currents on the organs of the dogs' bodies.

The Experiments.

In making the experiments the continuous current was supplied from an Edison 1,200 volt "Municipal" dynamo; the alternating from a Siemens machine excited by a 100-volt Edison belonging to the isolated plant at the college. A cage built up of wooden strips, and strengthened with heavy copper wire twisted into large meshes, was placed on the laboratory table in full view of the entire audience. It was about four feet in length, three feet high and three feet wide. One side of the roof was hinged as a door, and through this a dog was forced in spite of energetic struggling. He was a black retriever, weighing 76 pounds, apparently in good health. Electrical connections were made to him by attaching one conductor to his right fore leg, another to his left hind leg just above the foot. The limbs were first wrapped with wet cotton waste bound on with No. 20 bare copper wire, with which the leads were connected.

In response to an invitation from Mr. Brown, A. E. Kennelly of Edison's laboratory, Schuyler S. Wheeler, electrical engineer of the Board of Electrical Control, and T. Carpenter Smith, electrical engineer, who had come from Philadelphia in behalf of the Westinghouse company, assisted in making and checking the electrical connections and measurements. Considerable trouble was experienced in measuring the resistance of the animal, and the connections, but it was finally announced as 15,300 ohms.

The first experiments were made with the continuous current, the circuit being led through a relay so arranged that upon its being broken, the extra current arising from the discharge of the field magnets would not pass through the victim. A device of this kind had been suggested by Mr. Brown in his proposed rules for the supervision of central stations by the Board of Electrical Control. Without the diversion of the extra current, Mr. Brown stated that a continuous current of 500 volts electromotive force would kill the dog when the circuit was broken. The current used was two-tenths of an ampere, and the first application was at 300 volts e. m. f. The dog yelped and struggled until the circuit was broken, and, his behavior did not change materially under the successive application of 400, and then 500 volts. When 700 volts was reached, however, his efforts to escape became so violent that he succeeded in forcing his head out through the top of the cage, and for a few moments there seemed to be a strong probability that he might break loose. As Mr. Brown upon introducing the dog had announced that in spite of his mild appearance, he was really a dangerous character and had bitten two men there was an appearance of nervousness upon the part of some of the spectators, and Commissioner Moss quietly picked up his hat and departed, while his colleague Commissioner Gibbens took the precaution of securing a seat at the extreme rear. The exhibition had already assumed an aspect of inhumanity which was intensified by the application of 1,000 volts, when the tortured and terrified brute in his agony stretched himself out, suspended by a strap and twisted wire at his neck, clinging like a bat to the sides of the cage, from which position he apparently had not sufficient strength to release himself. Mr. Brown evidently perceived that the spectators as well as the dog were reaching the limit of endurance, and accordingly asked if any person desired that the pressure be raised to 1,200 volts. Receiving no response, he announced that he would then apply the alternating current from the Siemens machine, at a speed giving 288 alternations per second. In reply to an inquiry as to the resistance of the victim at that time, it was given as 2,100 ohms or less than one-seventh of the normal. Mr. Brown stated that he had no means of measuring the amperes of the alternating current, adding sarcastically that he would apply this current in order to make the dog feel better, as it had been stated by some of the advocates of the alternating system that this was the effect of the current used by them. T. Carpenter Smith asked for the name of the person who had made a statement of that character. Mr. Brown looked over the printed report of the arguments before the Board of Electrical Control, but was unable to find the expression he had quoted, and subsequently admitted that he was mistaken. He then said that he would be glad to have some representative of the alternating system name a voltage at which he should proceed with his experiments. While waiting a suggestion, C. H. Jackson announced that there were gentlemen present who would agree to take 1,000 volts from an alternating machine if Mr. Brown would take 1,000 volts from the municipal dynamo. This proposition was not received with enthusiasm by anybody, and no "takers" volunteered.

Some doubts being expressed as to the vitality of the dog, Dr. Peterson made an examination and stated he was still alive. A gentleman in the audience then begged that in the name of humanity the animal be killed at once. As this expression of opinion appeared to represent the feeling of the spectators, the switch was turned and with a short moan the dog expired, having been subjected to a shock of 330 volts from the alternating machine.

It was of course apparent that the reduced vitality of the dog together with the diminished resistance, had entirely changed the conditions, and Mr. Brown asked if he should provide another dog. A representative of the daily press, who is versed in electrical science, appealed to a superintendent of the Society for the Prevention of Cruelty to Animals, to prevent any further proceedings, as provision had not been made for accurate comparison of the different conditions, and consequently the tests had no scientific value. "Do you protest against the continuance of the experiments?" inquired the superintendent. "I do," replied the reporter; whereupon he announced that further torture of living animals would subject the principals to a fine of $250 and imprisonment for one year.

Mr. Brown assured Commissioner Gibbens, however, that arrangements could be made to continue the experiments privately.

At the School of Mines of Columbia college, August 9th, experiments were undertaken, at the request of Harold P. Brown, electrical engineer, to determine the danger of alternating currents, by Dr. Cyrus Edson and Dr. Charles F. Roberts of the New York Board of Health.

The first dog operated upon was a mongrel dog weighing 61 pounds, strong and in good condition. His height was 24 inches, length from tip of nose to base of tail 42 inches, and resistance from the right front leg to the left hind leg 14,000 ohms. Connection was made by binding a piece of cotton waste saturated with water round the leg with number 20 bare copper wire. The dog was placed in the cage and the alternating current applied by Dr. Roberts at 272.16 volts for five seconds, number of alternations 288 per second. The dog was silent and motionless during the continuance of the current. He gave a few spasmodic gasps 31 seconds after current was first supplied, and heart ceased beating 90 seconds after current was applied. The dog was immediately dissected by Dr. Roberts and Dr. Peterson, and sections of sciatic and pneumogastric nerves, muscular fibres of diaphragm and lungs placed under a microscope and no changes in structure were observed.

The second dog was a full-blooded Newfoundland, strong and in good condition, weighing 91 pounds, length from tip of nose to base of tail 48 inches, height 25 inches, resistance 8,000 ohms. Connection was made in the same manner as before. The alternating current was applied by Dr. Roberts at 340.5 volts electromotive force for five seconds. The dog was silent and motionless during continuance of current, howled and gasped for eight seconds after circuit was opened, but in the opinion of physicians present this was purely mechanical action as the dog was unconscious from the instant the current first reached him. Heart stopped beating in two minutes and fifty seconds after current was first applied.

The third dog was a half-breed setter and Newfoundland, weighing 53 pounds, 42 inches long from tip of nose to base of tail, and 24 inches high; resistance, 30,000 ohms. Connections were made in the same way as before. Dr. Roberts applied the alternating current at 220 volts for five seconds; the result was not fatal at four minutes afterward. Mr. Porter, superintendent of machinery of Columbia college, then suggested that as the dog was rigid and motionless during the continuance of the shock, it would be impossible for a man in the same condition to utter a sound or to break the contact in five seconds. Dr. Edson then determined to administer the current at the same number of volts for 30 seconds on this account and on account of the high resistance of this subject. This was done and during the period of the 30 seconds the voltage rose to 234 volts. The dog died instantly without sound or struggle. The resistance after death was found to be 2,800 ohms. All the physicians present expressed the opinion that a dog had a higher vitality than a man, and that therefore, a current

which killed a dog would be fatal to a man under the same conditions. It was their opinion that all of these deaths were painless, as the nerves were probably destroyed in less time than that required to transmit the impression to the brain of the subject.

Dr. Edson invited Prof. Elihu Thomson of Boston, and Dr. Otto A. Moses to be present with measuring instruments to check up the voltage, etc., but neither of these gentlemen put in an appearance or responded.

[Signed] DR. CYRUS EDSON, Prest. of the Board of Health; DR. CHARLES F. ROBERTS, Assistant Professor of Physiology of Bellevue Hospital Medical college; DR. FREDERICK PETERSON, DR. FRANK H. INGRAM, DR. H. A. HAUBALD, DR. SCHUYLER S. WHEELER, Electrician Board of Electrical Control; HAROLD P. BROWN, electrical engineer; JOHN MURRAY MITCHELL, PROF. C. E. COLBY, Columbia college; CAPT. E. L. ZALINSKI, U. S. A.; PROF. L. H. LYAUD, Columbia college.

(*Concluded.*)

The New York Board of Electrical Control.

REGULAR SESSION.

It was expected that the meeting of the Board of Electrical Control on Wednesday would be an unusually lively one, and with a little more time it might have been. President Jacob Hess was however anxions to get away early, as the Blaine reception was on his mind, while Secretary Moss looked as if breezy Long Branch would be a more congenial place to spend the noon-day hours. Commissioner Gibbens usually looks cool and comfortable, but on this particular occasion a bandage round his neck indicated that he had something to think of possibly more obnoxious to him than Mayor Hewitt. Just before the meeting was called to order three small boxes were passed around to the commissioners, who after diving into the pink cotton which they contained, brought out three large gold badges, suitably inscribed with the title of the board, which had been presented to the gentlemen by their friend Dr. A. Watts of Boston, who did not think the old silver badges becoming to the dignity of the honorable commissioners. The inspectors of the board will probably fall heirs to the latter.

Upon the meeting being called to order, it was voted that the reading of the minutes be dispensed with, and that the board proceed to authorize the signing of a letter which had been prepared to send to C. H. Read & Co., proprietors of the Hoffman house, who had already offered through the mayor to pay the expenses of removing the poles and wires on Twenty-fifth street, and which his honor had deemed it proper to decline. A similar communication to the board had, however, received different treatment, while the occasion was availed of to touch up Mayor Hewitt indirectly, copies of the letter being given to the press for publication.

The following extracts give an idea of the existing unpleasantness between these representatives of the people:

"It is perhaps unfortunate that the board has not the power primarily to sweep from the streets the poles and wires of companies for whom underground accommodations have been provided, but who have failed to comply with the provisions of the act requiring them to make use thereof. The legislature in its wisdom, desiring to interfere as little as possible with the action of the local authorities of the city, made it the duty of the commissioner of public works to supply and carry out the remedial clause of the law upon the order of the mayor, and had the mayor of the city issued such an order to the commissioner of public works five months ago there can be no question but that the obnoxious structures would have been removed, and companies operating overhead conductors would now be doing their business with underground wires.

"The failure of the mayor to perform his part and duty under the act has put off and retarded the accomplishment of the work contemplated and authorized by the legislature, and placed the Board of Electrical Control as well as the citizens of New York in the unpleasant position of being obliged to have constantly before their eyes the spectacle of corporations willfully, maliciously and inexcusably defying and disobeying the will of the people and the law of the land.

"The reply of the mayor to your communication is also before the board, in which we find reiterated the same oft-repeated excuses which he is in the habit of making for not performing his duty under the act of 1887, and which have so many times been met and the absurdity of which has been so frequently exploited by the leading newspapers of the city, as well as by the correspondence between his honor and this board.

"If it had been the intention of the legislature to make Abram S. Hewitt the controller of electrical conductors in the city of New York, it would no doubt have found language sufficiently precise to enable it to do so. What the legislature did in reality was to impose upon the mayor of the city a duty which Abram S. Hewitt refuses to perform.

"The mayor declares in his correspondence with you that if the poles and wires referred to are 'dead,' or not in use, or unnecessary to the business of the companies, the department of public works will remove them. The credulity of the mayor as to the efficiency of the department of public works in matters of this kind is characteristically entertaining. During the last month, that is to say, from July 8th to August 5th, the Board of Electrical Control has communicated to the department of public works 122 notices of 'dead' poles and wires not in use, and requested that department to remove the same. These notices cover ninety-one poles which are unnecessarily incumbering and obstructing the streets of the city, and hundreds of miles of wire, which are a constant menace to the lives and property of all of us.

"Each day adds to the number of poles and wires which the department is requested to remove. The very pole line on the north side of Twenty-fifth street, between Broadway and Sixth avenue, of which you complain, has been reported to the department of public works as carrying five 'dead' wires out of ten altogether on the poles.

"Notwithstanding all this, nothing has been done by the department toward removing these street obstructions, and the close of every day without action adds to the audacity and security of the corporations, which can violate the law of the land with apparent impunity as long as Abram S. Hewitt is at their back with all the machinery of the city government to invent legal complications and throw obstacles in the way of its enforcement."

It was unanimously voted that the letter as read be signed by the secretary of the board and forwarded to Messrs. Read & Co.

The president of the board was appointed a committee of one, to wait on the commissioners of fire and police, and ascertain what progress could be made toward putting the city wires underground. Mr. Gibbens here stated that the relations of the board with the departments in question had always been of the most friendly character.

To offset this announcement, a letter was read from General Newton, commissioner of public works, saying that the numerous complaints made for the removal of dead wires and poles from the streets had not been acted upon for the reason that they had been addressed to the bureau of street incumbrances, instead of to the department as should have been done. For this reason they had but very recently come to his notice and much valuable time had thus been lost. He also took occasion to say that these communications had been signed by Schuyler S. Wheeler, electrical expert, and that he had no official knowledge of that gentleman's authority to act in behalf of the board. In view of the fact that Superintendent Richardson of the bureau had been sent to the board with the request from the department of public works that they work together in harmony, Commissioner Gibbens thought the excuse made by General Newton was hardly acceptable, and upon his motion the letter was laid upon the table.

Commissioners Moss and Gibbens were appointed a committee of two to frame a suitable general permit for electric light wires through streets where no conduits were yet laid, and where such conductors were required for public lighting. So many applications were coming in that it was becoming a difficult matter to act upon them intelligently

The East River Electric Light company applied for immediate permission to erect eight poles on Twenty-fourth street, between First and Third avenues, to enable them to carry out their contract for public lighting on Ninth and Tenth avenues. This was considered an emergency, and a permit was accordingly granted.

Mr. Gibbens stated that, in conversation with the general manager of the telephone company, he had learned that they were incurring considerable expense in removing their overhead wires in compliance with the rules of the board, but that after having done so, a large number of dead wires remained belonging to other parties. Mr. Gibbens thought it would be wise to enlist the assistance of friendly electrical companies in obtaining the names of the owners of these dead wires as far as possible, and the secretary was instructed to communicate with them for that purpose.

Several weeks ago a rule was adopted to take effect August 1st to the effect that after that date no central station for electric lighting should be operated in the city of New York without having a certificate from the electrical expert of the board that it was properly installed. Owing to the vast amount of other work on hand connected with getting the existing overhead wires in proper condition, it was voted upon motion of Mr. Gibbens that this rule be suspended until it was found practicable to put it into operation.

Engineer Kearney was requested to report to the next meeting to what extent the underground construction company had carried out the instructions of the board in regard to the extension of subways, and what work they would be able to finish during the season.

Mr. Gibbens stated that it was the practice of the United States Illuminating company whenever they received a notice to the effect that certain of their wires were "dead," to inform the board that the alleged violation of the rules was in a district where the board had prohibited them from making any repairs. He therefore moved that the secretary direct their attention to the fact that such being the case it was all the more important that the abandoned wires and poles be removed without further delay. President Hess stated that he was willing to vote for almost anything that would keep Mr. Gibbens quiet, and the secretary was instructed accordingly.

Mr. Gibbens then stated that it had been demonstrated to the board within the past two weeks that alternating currents would kill, and that they were previously aware that high tension continuous currents were fatal. He would, therefore, suggest with the approval of the board that the electrical expert be requested to draw up such regulations as he might consider necessary for the best interests of the public. It was so ordered.

Dr. Wheeler had prepared for the information of the board a list of violations of the existing rules on the part of various companies and departments in the city but on account of pressure of other business it was not presented at this meeting. The following defects had been reported to the electric light companies: Brush company, dead poles 23, dead wires 4; United States Illuminating company, dead poles 44, dead wires 23; notices sent out for all companies 166, notices answered 23, notices attended to 40; total violations reported for two weeks 309. A report has also been prepared regarding the recent experiments upon dogs conducted by Harold P. Brown, electrical engineer, who was in attendance at the meeting. It is understood that it will be necessary to increase the present force of inspectors in order to bring about a more immediate reform in the condition of the wires in the city.

The St. Lawrence Marble company, whose headquarters are in Chicago, but whose quarries are located on the St. Lawrence River, are considering the advisability of using electric motors. They have an unlimited water power one mile away from their quarries. They use about 100 horse power in driving all their machinery and at present are paying about $10,000 per annum for fuel to run their steam plant.

CORRESPONDENCE.

New York Notes.

NEW YORK, August 11.—Coroner Nugent held an inquest August 7th in the case of Frederick S. Witte who was killed April 27th in front of 200 Bowery by jumping up and touching the arc lamp there. After a lengthy deliberation the jury decided that death was due to an electric shock, and that the United States Illuminating company was guilty of negligence in permitting the lamps to remain in an exposed position in a public place. The superintendent having testified that the lamps might be insulated at a small expense, the jury further censured the company for not having its wires and lamps properly insulated, and recommended the passage of an ordinance requiring all companies to insulate their lamps, and also to insert in their contracts a clause warning their customers of the danger arising from touching the lamps or wires.

Louis Mund, a Philadelphia lad 14 years of age, who was boarding at Albrecht's hotel, Atlantic City, was instantly killed on Tuesday while playing on the roof of the building where he took hold of the electric light wires where they cross over the premises. He had just been called down, and in descending had taken hold of the wire to steady himself. He staggered about two feet and fell dead. The same night about 12 o'clock, Edward Bross, in the employ of the Scranton, Pa., Electric Light, Heat & Power company was accidentally killed by falling from a high pole upon which the street lamps are hung. He was engaged in adjusting the carbons and was apparently startled by a shock which caused him to relax his hold and he fell to the ground, a distance of about forty feet, his neck being broken by the fall.

The lightning which accompanied the storm in this city and vicinity on Saturday night last was unusually severe. It followed the wires of the United States Illuminating company into their station at the foot of East 29th street, seriously damaging the wires and switch board, and setting fire to the building. The belting was seriously damaged by both fire and water, and the dynamos were saturated but not otherwise injured. There were very lively electric manifestations in the Western Union operating rooms, but business was not interfered with to any extent.

The Telephone Constructing company has been incorporated under the laws of this state, with a capital of $30,000 divided into 300 shares, Charles A. Beardsley, D. Frank Lloyd, and John F. Shelly, all of this city, each taking a third. The object of the company is reported to be the construction of telegraph and telephone lines from the city of Valdivia, Chili, through the states of Bolivia, Ecuador, and Columbia, thence to New York city, where their principal office is to be located.

Mr. Quintard, supervisor at large, of Kings county, has sent a communication to the board of supervisors, calling the attention of the board to the expense of supplying gas to the Raymond street jail in the city of Brooklyn. The bills amounted to $8,000 in 1887 and this year they are expected to reach $10,000. Mr. Quintard says it is impossible to believe that the bills are legitimate, and he recommends the substitution of electricity for gas, the county to own its own plant for that purpose.

The annual meeting of the Postal Telegraph Cable company's stockholders was held on Tuesday at the office of the company, 1 Broadway. Levi P. Morton, who has been a member of the board of directors for some years, sent in his resignation, and the following board was elected for the ensuing year: John W. Mackay of California; William C. Van Horne, Charles R. Hosmer, and Sir George Stevens of Montreal; Albert B. Chandler, Henry Rosener, Hector De Castro, Edward C. Platt, and George G. Ward of this city. The old board of officers were re-elected.

E. S. Coykendall, of Deckertown, N. J., is thought to have had the most peculiar experience with lightning of any person living. He has been in four tussles with the electric current, each time, however, coming out successfully. He is an old man now, hale and hearty, and delights in telling of his hairbreadth escapes. The first experience was about fifty years ago, when he was a mere lad. He, with his parents, was visiting Isaac Conrsen. While there the worst electric storm ever known came up and the house of Mr. Coursen was struck and torn into fragments, parts of it being scattered over a field ten acres in extent. Mr. Coykendall had retired for the night, and becoming frightened called to his parents. They had reached the head of the stairs when the bolt came and they were both killed. Young Coykendall was fished out of the ruins in an unconscious state. A physician was summoned, and it was found that the bolt had struck him on the forehead, crushing the skull and paralyzing every nerve. It was necessary to take out a portion of the skull and insert a piece of silver as a substitute. The piece inserted was a Spanish twenty-five

cent piece, and a large scar now marks its location. Not long after he was riding on horseback near the village during a shower when there was a blinding flash and he was thrown from his horse. The horse was killed instantly, but Coykendall was only stunned and recovered after a time. A few years later, while sitting in front of his stove at home, a bolt descended the chimney, and, pursuing its course down the stovepipe to the stove, again knocked him senseless, at the same scattering the fire, stove-lids and ashes in every direction. He was picked up unconscious and bleeding, and badly injured from pieces of stove metal, but he soon recovered. His fourth and last experience was on a farm. He was in a haymow when it was struck near him. He was knocked senseless and the mow was set on fire and he came near being burned to death, but with careful nursing came out all right.

Cyrus P. Dakin, the inventor of carbon paper, which has been so extensively used for years by telegraph companies and the press, died at his residence in Jersey City on Sunday morning last at the advanced age of eighty-eight years. P.

From Louisville, Ky.

LOUISVILLE, Ky., August 10.—The city law makers have again been dabbling in electrical matters. At the last meeting of this body a resolution was offered to have all telegraph, telephone and electric light wires removed whenever they are to be found within twenty-six feet of the street surface. This is done on account of the big fall celebration that Louisville is to have, one of whose chief features will be a grand street parade, containing elaborately designed floats, illustrating various kinds of business. It is feared that unless the wires are placed at the requisite height of twenty-six feet they will interfere with the parade.

It was finally decided to appoint a committee to visit the companies owning the wires and ask them to raise the wires high enough to clear the streets along which the parade will go. This committee was appointed and has been conferring with the companies. The latter will comply with the request, although it will entail considerable expense and trouble.

It has been finally decided that Louisville shall have the grand electric light street illumination during September. A large amount of money will be spent on this. The electric light men will make great efforts to have a grand display, and every species of light will be shown.

Yesterday the contract for lighting the Louisville custom house was awarded. A home concern—the Louisville Electric company—secured the award. The interior of the building will be lighted by 150 incandescent lights, and outside there will be arc lights. This contract will be in force three years, and the government will pay $4,000 a year for the service.

Some of the electric light companies here are making improvements. The Louisville Electric Light company has just completed a large new brick building, with very handsomely fitted up offices in the front portion. Several large retail stores which have been using gas have recently put in electric lights. A.

From the Pacific Slope.

SAN FRANCISCO, Cal., August 5.—In the course of another month the Pacific Coast Steamship company's steamer Queen of the Pacific, wrecked some months ago at Port Hartford, Cal., will again be in service. The accident which befell her April 30th last, necessitated her undergoing extensive and costly repairs, including an entirely new electrical plant. The old plant, installed a little over six years ago, was beginning to look quite ancient. It consisted of two 125 light incandescent dynamos, a small 6 light arc dynamo and another small Maxim dynamo operating an electric search light, together with independent engines. The Maxim machine is being retained to again operate the search light, but the incandescent plant is superseded by a modern Brush plant. The Queen is the first boat on the Pacific coast having a Brush incandescent plant. The installation has been done in a very creditable manner by the California Electric Light company. It consists of one 450 light Brush dynamo, operated by a Ball engine. A noteworthy feature of this installation is the large number of sectional mains running from various parts of the boat directly to the machine They number nineteen and average a little over twenty-three lights per main. H.

Indianapolis News.

INDIANAPOLIS, Ind., August 10.—The Dudley Electric Street Railroad company are in hard luck. Whenever they begin work on a new street the Citizens' Street railway puts a gang on the same street and begins laying track. Tuesday of this week the police were called on prevent a rio both companies were making on Madison avenue, where the Citizens' company had begun tearing up the Dudley track. As there were about 500 men in the two gangs it looked serious for awhile.

At a regular meeting of the city council Monday night resolutions were introduced and adopted instructing the street commissioner to put a stop to the Dudley company's tearing up any more streets. At a called meeting of the council Tuesday night, after a conference between the Dudley representatives and the mayor and city attorney, the former agreed to stop work, put the streets in good condition, and await a decision of their case by the Supreme court, provided the city would guarantee them against loss of their privileges and rights on account of the necessary delay. A resolution to this effect was presented and adopted.

The council also granted another company, known as the McNeal Electric street railroad, a franchise allowing them to operate on several streets mentioned. This looks like more trouble.

The Brush Electric Light company notified the city council Monday night of its acceptance of the contract for city lighting. The company is now stringing wires and will be ready for operations soon.

The Jenney Electric company are placing lamps and electroliers in position in the new union railway station. M.

St. Louis, Mo.

ST. LOUIS, Mo., August 10.—Geo. J. Percival reports the sale of a 75 light incandescent outfit to the St. Louis Candy company. A simplex arc lamp will also be used on this circuit.

The Brush-Julien motor car still continues to run regularly. This car is one of the smoothest riding cars in the city. It is lighted throughout by incandescent lights.

The Heisler Electric Light company will light the art gallery of the coming exposition with their long distance incandescent system. About 600 thirty candle power amps will be used.

The Twelfth street car line expect to have a Wharton car in operation in a few days.

The Davis Carbon company report business good for this season of the year.

During a storm the other day a man was killed by lightning while sitting in a summer house in Lafayette Park. This house has an iron roof suspended by six cedar posts. Three of these posts were badly splintered while the other three were not marred. The man was leaning against one of the posts which was struck.

There has been considerable petty thieving going on around one of the electric light stations. The thief could not be caught, so this remedy was tried: A large piece of brass was laid in the window sill. This was connected to a 20 light circuit known to be slightly grounded. In due time the thief arrived. He caught at the bait and in less time than it takes to tell it he was landed in the center of the street. Nothing has been missed since. B.

From St. Joseph, Mo.

ST. JOSEPH, Mo., August 14.—D. W. Guernsey, president of the St. Louis Electric Power company and western agent for the Sprague Motor company of New York, has been awarded the contract for building the Wyatt Park street railway.

At a recent meeting of the Union Railway company, the number of directors was increased from seven to eight, and the capital stock increased from $75,000 to $150,000. The company is so well satisfied with the operation of its electric motor system that it will be extended to the southern city limits as rapidly as possible. D.

THE ELECTRIC LIGHT.

The Excelsior plant at the Union stock yards, Chicago, has been started and is working very satisfactorily.

Foree Bain of Chicago is constructing a new 2,500 light switch-board for the Louisiana Electric Light company of New Orleans, La.

An ordinance providing for the introduction of an electric light plant was adopted by the board of aldermen of Galena, Ill., August 8th.

The plant of the East End Electric Light company at Pittsburgh, Pa., was damaged to the extent of $30,000 by fire August 9th. The property was insured.

The Citizens' Electric Light company of Collinsville, Ill., has been incorporated. Capital stock, $100,000. Incorporators, S. W. Baird, S. P. Baird and M. T. Baird.

The Edison Electric Illuminating company of Rochester, N. Y., have ordered another Woodbury high speed engine, in order to keep pace with the demand made upon them.

During the first six months of 1888 eighty electric light plants for central station lighting have been established in the south. During the same time eighteen gas plants were established.

K. Iwadare, mechanical engineer of the Osaka Electric Light company of Osaka, Japan, who has been studying different systems of electric lighting in America for several months, has ordered a Thomson-Houston plant and six 120 horse power Woodbury high speed engines with boilers to match.

Articles of incorporation of the Edison Electric Light & Power company of Minneapolis, Minn., were filed last week. The capital stock is placed at $500,000 and the incorporators are T. B. Walker, Henry C. Oakley, Charles H. Chadburn, S. G. Cook and W. W. Huntington of Minneapolis and Willard H. Churchill of New York, who constitute the first board of directors. The company has purchased a piece of land 60 by 100 feet in the middle of the square on which the Lumber exchange stands, and will put up a fire proof structure of ten stories. The lower floor will contain the dynamos, thirty-six of which will be put in immediately. The upper floors are intended for the use of job printers, to whom motive power will be furnished. The cost of the plant is estimated at $250,000, and it is expected that the station will be in running order by December 1st. There is some talk of running street cars in Minneapolis by electricity, in which case Sprague motors will be put in.

THE ELECTRIC MOTOR.

The Red Wing, Minn., Electric Light & Power company has been incorporated with $50,000 capital stock.

It is reported that William H. Armstrong, who owns the right to construct on the Pacific coast the motors of the Electric Car company, will soon erect a manufactory in San Francisco.

The Leader Printing company of Des Moines, Iowa, have ordered a fifteen horse power Sprague motor, in addition to a five horse power they now have, from H. O. Woodruff, local agent.

A Dayton, Ohio, dispatch, of August 9th says: "By the crossing of wires the full power from the electric street railway dynamos was turned into the telephone exchange, setting on fire and destroying six hundred telephones throughout the city, completely shutting off all telephone business."

Among the attractions of the forthcoming exhibition at Paris will be a veritable "Belt Line" of railroad, by means of which visitors will be enabled to make a tour of the exhibition grounds in the Champ-de-Mars without fatigue. The endless train will consist of 400 platform cars somewhat similar to those used for freight, the line being sunk so that the floor of the cars will be exactly level with the ground. The train will be run at a sufficiently slow speed to enable most persons to get on and off while it is in motion, but to enable elderly persons, females and children to mount, descend, or pass over the moving platform, there will be stoppages of fifteen seconds every minute. The motive power will be electricity.

A very small story is told in a very large way in the following press dispatch dated at Pittsburgh, Pa., August 13th. It is worthy of insertion here, as it is one of the first accidents to electrical railways reported. It is highly probable the cause of the accident is found in a defective casting which is not infrequent in any construction where cast iron is used: The passengers on a car on the St. Clair electric railway were treated to an experience so thrilling this afternoon that they will remember it as long as they live. Shortly after 1 o'clock, as one of the cars neared the brow of Mount Oliver, the casting attached to the sprocket wheel broke. The casting broke just as the motor and car were about to go on the upper end of a trestle which runs from Pius to South Sixteenth streets. When the accident occurred, the engineer lost his presence of mind and jumped from the engine just before it reached the trestle, and the car dashed headlong down the mountain side. Conductor Smythe took in the situation at a glance and applied the car brakes, which checked the speed slightly. There were three children and one lady in the car when it started on its mad flight, and they became very much excited, and tried to get off the car while it was crossing the trestle, but fortunately Conductor Smythe succeeded in quieting them. At the bottom of Mount Oliver there is a short turn in the road, and when the motor and car reached this point the former left the track and the car came to a standstill. In swinging around the curve Conductor Smythe and a lady passenger were thrown off and severely injured. The other three passengers were not hurt. The car was not damaged in the slightest, and the only harm done to the motor was the breaking of the casting. These cars have only been running a short time and nearly every time they are crowded with people. Yesterday the road carried thousands of pleasure-seekers.

THE TELEGRAPH.

It is currently reported in the City of Mexico that the Mexican Telegraph company is making arrangements to lay a new cable in order to meet the demands of its increased business. Congress will be called upon at its next session to establish a new cabinet office, that of minister of posts and telegraphs.

Senator Spooner's inter-state telegraph bill was passed by the United States senate August 9th. The measure is an attempt at government regulation of the telegraph through the agency of the Inter-State commerce commission. The bill in its main features follows the inter-state railroad law. It requires that charges shall be reasonable and just, prohibits discrimination, and forbids the charging of any more for a shorter than for a longer distance over the same line. Pooling by competing lines, is prohibited. While drawbacks, rebates, special rates, and the like are forbidden, it is lawful for companies to carry messages for the press intended for publication as news at lower than regular rates. But there must be no discrimination between newspapers. Rates are to be published by the telegraph companies in such manner as the commission may prescribe. A remedy for damages will lie either in the United States courts or in the commission. The commission is to have the same jurisdiction over telegraph companies, in so far as may be necessary for carrying out of the law as it has over com-

mon carriers under the inter-state commerce act. Full and stringent provision is made for court proceedings to enforce any finding of the commission. A requirement that will not please the stock jobbers, though it may benefit the public, compels the telegraph companies to make annual reports to the commission. These reports are to show the amount of capital stock issued, the amounts paid therefor, and the manner of payment; the dividends paid, the surplus fund, if any, the number of stockholders, the funded and floating debts, and the interest paid thereon; the cost and value of the company's property, franchises, and equipment, the number of employes and the salaries paid each class; the amounts expended for improvements each year, how each ended, and the character of such improvements; the earnings and receipts from each branch of business and from all sources; the operating and other expenses—the balance of profit and loss—and a complete exhibit of the financial operations of the company each year, including an annual balance sheet. Outside of the general fact of government regulation the two important provisions of the bill are the prohibition of discrimination between newspapers and the opening of the books in the annual report. The house has had an inter-state telegraph bill on its calendar for months.

The Maine Central Railroad company, through their counsel, Messrs. Baker and Cornish of Augusta, have brought a bill in equity to enjoin the Postal Telegraph Cable company of New York, from constructing a telegraph line along the railroad company's location between Mattawamkeag and Vanceboro. The railroad commissioner granted the postal company this right under an act passed by the legislature of Maine in 1885, and the construction had commenced when the bill for injunction was served. The railroad company claim that the act of 1885 is unconstitutional. This opposition to the Postal Telegraph company's plans in Maine is really the continuation of the old fight between the Gould and Mackay telegraph companies, Mackay desiring to obtain land connection for his cables between Halifax and New York. The cable company set its first pole at Vanceboro, August 9th, but construction has been suspended to await the decision of the court.

A dispatch from Montreal dated August 6th runs: "Owen Jones, president of the Trans-Pacific Cable company, arrived here yesterday by way of the Canadian Pacific railway from Australia and New Zealand. He comes here to have an interview with Sir John Macdonald regarding the scheme for a cable from Victoria, B. C., to Australia via Honolulu, the Fiji Islands, and New Zealand, connection thus being had between England and her antipodean colony over lines and through cables for a distance of 12,000 miles entirely English or controlled by English capital and in British possessions. The scheme was originated by Sanford Fleming of Ottawa, but Mr. Jones has taken it up, and for the past three years has been working assiduously at it. With this object in view he has traveled entirely around the globe and visited the different colonial governments, and, after his interview with the Canadian premier, will go to London, where he will close his labors by an understanding with the imperial government. The English man-of-war Egeria is already surveying the route for the Pacific cable, a work which will occupy at least two years."

Miscellaneous Notes.

The Electric Date and Time Stamp company of East St. Louis, Ill., has been incorporated. Capital stock, $1,000,000. Incorporators, William H. Stevenson, Henry H. Werner, James B. Johnson, J. M. Thompson, and Hamilton Daughorday.

"I may be overly sensitive, but I fully believe that had I remained in my position as gripman my hair would have been gray long before now. The general public have little idea of the constant strain on a man's nervous system who fills a position of this kind," says a retired gripman in the *Globe-Democrat*.

M. de Myngelas has lately devised a process for obtaining magnesium by electrolysis, says the London *Electrician*. An alloy of magnesium is first obtained in the form of an electrolytic deposit. The bath consists of a concentrated solution of chloride of magnesium, combined with an equally concentrated solution of the chloride of any other metal except aluminum. The solution preferred is one part of chloride of zinc and two parts of chloride of magnesium. The two solutions mark 18 degrees on the Beaume scale. Good results are obtained by using the electrolytic bath as the battery. The external jar contains the double chloride solution and the copper cathode, the amalgamated zinc anode is placed in dilute sulphuric acid. The zinc is deposited in a "spicular" or "arborescent" form, and the magnesium in granular crystals. This alloy is then washed, dried, and crushed, and finally melted in a crucible containing chloride of sodium. The zinc volatilizes and leaves pure magnesium.

New York had a severe storm accompanied by unusually vivid lightning August 4th. A dispatch gives these particulars: Lightning played about the lofty telegraph poles and the tangled masses of wires that they support in the down-town quarter. The cracking of the electricity, as it joined the artificial circuits, could be plainly heard by those who sat in the upper stories and near the open windows of the newspaper offices. About the time that the storm first began to rumble what appeared to be a ball of fire started from the main switch-board in the operating-room of the Western Union building, and burst into innumerable dazzling sparks. The whole place for an instant seemed ablaze. The startled operators, nearly 200 in number, made a rush for the door, led by a score or more of telegraph messenger boys. Havoc was played with the electric light system in the streets. Broadway from Park Row to Bowling Green and several of the side streets were left in total darkness, and on the big thoroughfares fitful sparks could be seen burning away the covering of the insulated wires. Lightning struck the wires in front of 414 East Twenty-ninth street and passed along into the building, which is occupied by the United States Electric Illuminating company as one of its stations. The lightning struck the switch-board on the top floor, setting fire to this apparatus. The flames spread, and in a few seconds reached the roof. The fire department responded, and soon extinguished the flames. Lightning struck the electric wire in front of the St. Denis Hotel restaurant, corner of Broadway and Eleventh street, and did much damage. The electric light at 629 Third avenue set fire to the front of the building. An alarm was sent out, and the fire was extinguished. The storm on Long Island was severe, and it is believed that an immense amount of damage was done. Telephone and telegraph wires went down in all directions, and communication with all points was practically shut off.

The following stanzas, written by Rev. Horatio Nelson Powers, constituted the first phonograph message received from England by Mr. Edison:

I seize the palpitating air I hoard
Music and speech. All lips that breathe are mine.
I speak, and the inviolable word
Authenticates its origin and sign.

I am a tomb, a paradise, a throne,
An angel, prophet, slave, immortal friend.
My living records, in their native tone,
Convict the knave, and disputations end.

In me are souls embalmed I am an ear
Flawless as truth, and truth's own tongue am I.
I am a resurrection—men may hear
The quick and dead converse as I reply

Hail English shores and homes and marts of peace!
New trophies, Gouraud, yet are to be won.
May sweetness, light, and brotherhood increase—
I am the latest born of Edison.

We might attempt, but we should lamentably fail, to describe the part electricity is destined to play in our household economy, says the London *Electrical Engineer*. It should give us light—it should give us power. Why should it not lock and unlock all our doors, and secure our windows from burglarious attacks? Of course we cannot prevent the breaking of a pane of glass or of the panel of a door, but there is no difficulty in so arranging electric apparatus that no door or window can possibly be opened in the ordinary way. The expense to utilize the services of electricity will be comparatively small when the architect provides for its use from the first. There is no reason for door knobs or keyholes; an electro magnet can form a key as efficient as any ever found out by Chubb. Indeed, it would not be very difficult to provide an instantaneous punishment for any one attempting to tamper with the fastenings of doors and windows, or at any rate to guarantee immediate detection. The vista of possible business when the application of electricity becomes so general is entrancing, and its realization depends upon the way we manage to educate the architect. Let him be recognized as a power, and be treated accordingly.

"At last the copper syndicate has the satisfaction of observing that the deliveries in France and England are on the increase," says the London *Daily News* of August 2d. "Last month, the deliveries, according to Messrs. Merton's statistics, were 9,766 tons, having been little over an average of 5,500 tons per month during the previous six months. Earlier in the year the rise in the price of copper had its natural effect of causing consumers to hold off from the market as long and as much as possible. At length, however, deliveries have got back to a normal rate, and even somewhat beyond. For the past twelve months the average monthly deliveries of copper in France and England has been 8,031 tons, while for the previous two years, the monthly average was about 7,750 tons, so that the deliveries last month were large and not small by comparison. At the same time stocks in England and France and on passage from Chili and Australia are put at 75,412 tons, being nearly half as much again as at this time last year, and about 15,000 more than the average stock in the year 1886. During the last seven months the stock has been increasing at the rate of five thousand tons per month, and unless the deliveries are maintained at something like the rate reported for July, the syndicate may be in trouble either next year or soon afterward. It is remarkable that, notwithstanding the increased consumption of copper during July, the visible supply increased by 3,169 tons for the month."

A very interesting question is set afloat by the London *Electrical Engineer* regarding means for indicating the electrical action generated in human and other bodies in the following: "In the *English Mechanic* for last week a sketch is given of an instrument invented some forty years ago by Mr. Rutter to indicate the electrical action generated in human and other bodies. It consists simply of a glass shade in which a single silk fiber suspends a pendulum bob of wax, swinging clear of a circular piece of glass on the bottom of the stand, which circle of glass covers a paper marked with concentric circles. The neck is suspended through a hole in the top of the shade and is carried by a brass arm springing from an unlacquered knob on the wood stand, and all wood and metal is free from varnish. To use it, the right index finger is placed upon the knob, and sundry movements are said to result in the wax pendulum according to the state of health and sex of the operator, and being stronger when several operators are connected in series. It is well known that Prof. Crookes invented the radiometer while experimenting for traces of electrical or other similar action of the human body, and as the action of the nerves is probably electrical or akin to that action, the tracing of an inductive effect under proper circumstances might be expected, and possibly even the effects of free electricity or magnetism, of either the usual or a more occult kind, might be perceived. We are not aware that anything really scientific has ever come of these experiments, but perhaps some of our readers may have heard of such experiments being performed with definite result.

Personal.

The marriage of Ayres D. Lundy, engineer of the Sprague Electric Equipment company, and Miss Mary Thompson was celebrated a week ago last Wednesday at Topeka, Kan. They left for the east on their wedding tour which will close at Davenport, Iowa, where Mr. Lundy is superintending the installation of an electric railway.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	345	360
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	44	47
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	110	112
Bell of Mo.	150	155
Iowa Union	27	28
Missouri and Kansas	70	71

Business Mention.

Last week the western department of the Sprague Electric Motor and Railway company, the rotunda, Rookery, Chicago, sold one 3 horse power motor, one 5 horse power and one 7½ horse power motor.

The agency of the Guion Automatic Heat Regulating company has been secured by the Western Electric company, who will push the sale of this apparatus vigorously. They will exhibit the apparatus at the exposition in Chicago this fall.

A Cincinnati dispatch, dated the 8th, says: "About half-past 8 o'clock last night a sharp flash of lightning, followed up by a terrifice peal of thunder, startled the large crowd in the Exposition buildings. Instantly all the arc lights in the building went out and the government exhibit and Machinery hall were left in darkness. The incandescent lights were not affected. It seems that the electric current struck the dynamos and extinguished the lights. The lightning produced a counteracting current and stopped the machinery instantly. When the current had passed the dynamos were started up again all right, and where there was darkness again was light. The rainfall following the thunder and lightning was so heavy that the noise drowned the rumbling of the machinery. The arc lighting apparatus of the Western Electric company escaped without damage owing to the efficiency of the lightning arresters with which it is equipped.

The following from the *Democrat and Chronicle* of Rochester, N. Y., published under date of August 7th, is a handsome testimonial to the merits of a first-class engine: "For a number of months past, K. Iwadare, mechanical engineer for the Osaka Electric Light company of Osaka, Japan, has been in this country studying the different American systems of electric lighting, and the power outfits used in connection therewith. Early in his investigations he was favorably impressed with the splendid performance of the Woodbury engines, especially with those at the Edison electric light station in our city, where he had an opportunity for comparison with four engines from other first-class establishments. After much traveling about and careful consideration, he returned to Rochester and placed his order with the Woodbury Engine company for one of their 120 horse power high speed engines, being the first of six which will be required to complete their plant. The first shipment was made via the New York Central and Hudson River railroad, last Saturday evening, and the shippers have been apprised by telegram that it arrived in New York city early Monday morning. This is remarkably fast time for such heavy freight. The steamer which will carry the engine to Japan, leaves New York city August 8th, rounding Cape Horn, and will be about three months on the journey. We understand that the Woodbury Engine company are now putting into Copeland & Durgin's furniture establishment, of our city, one of their high speed engines, of 160 horse power, in connection with two 100 horse power boilers. One of the members of the Woodbury Engine company informs us that they have one of the smaller sizes of their high speed engines running constantly at their works, at a speed of 340 revolutions per minute, and they would be glad to have any one who may be interested call and see performance. They call it good."

There have been several announcements recently, both in this country and in England, of discoveries of methods of producing cheap aluminum. Still, the new metal is not commercially cheap, nor have any of these discoveries so far materialized as to give to the world a supply of this wonderful metal, says *Iron*. There is a concern operating quietly in Jersey City, the Williams Aluminum company, whose office is at 95 Liberty street, New York, which, without making any announcement of a discovery, are now producing cheaply two valuable alloys of aluminum and iron, one for use with cast iron, and one for steel. The former is called aluminum ferro silicon, and the latter, ferro-aluminum. These alloys have already been widely used, and are proving of great value in foundry practice, and a considerable demand has sprung up for the product from iron and steel works in various parts of the country. The statement is made that when this aluminum-ferro-silicon is used in the proportion of ten pounds to every ton of molten iron, it greatly improves foundry practice. It is used in the ladle, and the metal is poured upon it without stirring. It cleanses the metal effectually by reducing oxides, and renders it very fluid. It gives life to the metal, raises its setting point and lowers its chilling point, so that castings take form quietly, while the thinner parts are not so apt to be hard and brittle, or cracked by the shrinkage caused by sudden changes of temperature. Being more fluid, sharper castings result, and under the tool are found to be softer and their strength is also increased. The percentage of defective castings in any foundry is a vexatious loss, and as they are but scrap, that has cost the price of the regular pig, there seems to be no doubt that this new alloy, which lessens this large percentage of loss to the founder, and gives him such improvement in his practice, will find a large and increasing demand. The loss by defective castings

was thus stated by a prominent stove concern which had figured it: "Every pound of faulty casting takes the profit on eight pounds of a good castings to make the loss good." To lessen this loss, as well as to give sharper, stronger, and softer castings, without blow holes, is the mission of this new alloy, and an important mission it is. The alloy is sold for ten cents per pound, and its use in the very small proportion to the ton of iron named above, gives results at such trifling additional cost that it will find its way to very general foundry use, and the announcement of it should be of interest to the entire iron trade of the country.

New York city has not been a good field for electric motors up to the present time on account of the subway and kindred restrictions. Notwithstanding, the C. & C. Electric Motor company have succeeded in making 115 installations, embracing 300 motors ranging in power from ⅛ to 5 horse power, the division being as follows: ⅛ horse power motors, 260; ¼, 8; ½, 19; 1, 6; 2, 2; 3, 1, and 5 horse power, 2. A list of the places in which these motors are installed and the number in each place follows: Huber & Seefried, 354 6th avenue, 1; American Express company, 65 Broadway, 1, running 3 stamp outfits; H. A. Bang, 1214 Broadway, 1; C. Gosford, 19 New, 1; H. & J. Blenderman, 100 West, 1; H. & J. Blenderman, 193 Washington, 1; *Evening Post*, 206 Broadway, 1; E. Lanters, 535 Broadway, 1; Jas. Duffy, 74 Beaver, 1; H. B. Christensen, 26 Church, 1; De Lacy & Co., 5 Barclay, 3; Equitable Life Assurance company, 120 Broadway, 60; L. Bonet, 927 Broadway, 1; R. H. Hutchinson, 250 Bowery, 2; St. Paul's Chapel, Broadway and Fulton, 1; Dawsonamel company, 15 E. 17th, 2; Goodwin, Strong & Co., 713 Broadway, 1; W. H. Rodier, 208 Fulton, 5; John Bostleman, 102 West, 1; Niagara Fire Insurance company, 135 Broadway, 1; H. Peterson, 74 Park Place, 1; Conservatory of Music, 21 E. 14th, 1; Oppenheim & Isaac, 66 Grand, 1; Dorlan & Schaffer, 13 Fulton Market, 1; Stahl Bros. & Levine, 91 Grand, 2; E. Ferris & Co., 185 Washington, 1; Lowe & Co., 210 Fulton, 1; Long Island Machine Embroidery company, 384 Canal, 8; Princess of Wales company, 458 Broadway, 12; Brush Electric Illuminating company, 208 Elizabeth, 2, Calumet club, 29th street and 5th avenue, 1; *Electrical Review*, 13 Park Row, 1; Electric club, 17 E. 22d, 3; Fahnestock & Co., 2 Wall, 1; Koster & Bial, 24th and 6th avenue, 3; Lotos club, 21st and 5th avenue, 1; Howard & Morse, 45 Fulton, 2; J. O'Neil, 22d and 6th avenue, 1; U. S. Illuminating company, 208 Fulton, 2; U. S. Illuminating company, 59 Liberty, 5; T. Mundorff, 1173 Broadway, 1; R. W. Zundell & Co., 2 Fulton, 1; Norman & Dunker, 90 John, 1; Blanchard & Co., 36 John, 1; J. Peiser, 171 Broadway, 2; Northwestern Mutual Life Insurance company, 13 Park Row, 1; Chas. Pfizer, 81 Maiden Lane, 1; Mather & Wentworth, 16 Maiden Lane, 1; N. Y. Stock exchange, 13 Wall, 6; Ira Perego, 128 Fulton, 1; J. F. Scott & Co., 4 Maiden Lane, 1; J. N. Ceballos & Co., 80 Wall, 3; G. B. Rolfe, 42 John, 1; Shannon, Miller & Crane, 46 Maiden Lane, 1; R. Kolb, 164 Pearl, 1; H. W. Johns' Manufacturing company, 87 Maiden Lane, 1; Lanman & Kemp, 70 William, 1; W. H. Bennett, 91 Wall, 1; McDougal & Sprague, 97 Wall, 1; W. P. Wight & Co., 74 Broadway, 1; Blake Bros., 5 Nassau, 1; *Mail and Express*, 23 Park Row, 1; J. V. Robins, 54 John, 1; Selchow & Righter, 41 John, 1; B. F. Coleman, 13 Park Row, 1; F. & H. Lemmerman, 2 Fulton, 1; I. Abrahams, 42 Fulton, 1; Crass & Begulin, 21 Maiden Lane, 1; C. Tarana, 9 Cortlandt, 1; O. M. Farrand, 3 Maiden Lane, 1; N. Y. Belting and Packing company, 13 Park Row, 4; C. A. Cheever, 13 Park Row, 1; The Okonite company, 13 Park Row, 2; A. Lorsch & Co., 37 Maiden Lane, 1; Henry & Frank, 2 Cortland, 1; P. Newman, 2 Cortlandt, 1; Mark Meyer, 100 Fulton, 1; De Lacy & Co., 33 Park Row, 1; Prince & Whitney, 66 Broadway, 1; Potter-Lovell company, 10 Wall, 1; International hotel, 15 Park Row, 1; Merrit's Rest, 139 Broadway, 1; Harris Bros., 176 Broadway, 1; I. B. Kleinert, 79 Spring, 1; Hallenberg & Lowenstein, 484 Broadway, 10; A. H. Ward & Co., 54 Mercer, 1; Van Lieu & De Forrest, 617 W. 52d, 1; Vocalion Organ company, 24 E. 23d, 1; U. S. Supply company, 51 John, 1; Union Special Sewing Machine company 47 Leonard, 1; G. H. Peel, 20 West 43d, 1; F. B. Starr, 206 Fifth avenue, 1; J. Stock, 204 Fulton, 1; Parke, Davis & Co., 60 Maiden Lane, 1; Metropolitan Life Insurance company, Church and Park Place, 1; A. Mander, 91 Nassau, 1; A. Levy & Bro., 614 Broadway, 1; R. Loeb, 55 Walker, 1; E. Hurley, 424 W. 57th, 1; Franklin Photo Electric company, 305 Pearl, 2, stamp outfit; Domestic Sewing Machine company, 14th street and Broadway, 5; J. H. Clark, 927 Broadway, 3; Crichton & Co., 225 Fulton, 1; Consolidated Patent Shirt company, 712 Broadway, 3; L. S. Cox & Co., 72 Walker, 4; G. A. Castor & Co., La Fayette Place, 2; A Benjamin & Co., 106 Bleeker, 36; American Exchange National bank, 116 Broadway, 1; L. Achtelstatter, 143 Fulton, 1; Benedict Bros., 171 Broadway, 1

Electrical Patents.

Issued August 7, 1888.

387,276. Electric Clock Synchronizer. Arthur G. Wiseman, St. Louis, Mo.

The invention relates to improvements in clock synchronizing devices, whereby a current of electricity transmitted from a regulating clock once every hour is caused to automatically synchronize other clocks by bringing the minute hand exactly to the point of twelve on the dial.

387,286. Apparatus for Treating Noxious Gases with Electricity. Hartley Fewson, Buckingham, County of Bucks, England.

387,310. Electro-Mechanical Movement. Richard H. Mather, Windsor, Conn.

Claim 1 follows: "A cylindrical iron case which is wholly closed at the base, a close fitting annular iron cap by which said case is partly closed at the top, and a magnetizable rod or core which is rigidly inserted in said base and extends axially through said case and through the middle of said cap, in combination with a helix of insulated wire which is inclosed in said case, and a movable spool shaped solenoid which incloses a variable portion of the free end of said core and has a constant number of its individual helices within the annular space which is formed between said core and said annular cap."

387,316. Railway Signaling System. Edward L. Orcutt, Somerville, Mass.

The arrangement of the system is such that upon entering a section of track equipped with the invention, the train receives either a positive safety signal or a positive danger signal, thus enabling the engineer to avoid accidents.

387,343. Dynamo Electric Machine and Electric Motor. Rookes E. B. Crompton, London, England.

387,347. Amalgamator. Adam H. Eysaman, Dayton, Nev.

387,365. Electric Switch Lock. Edward L. Orcutt, Somerville, Mass.

The object of the invention is to provide means whereby a switch may be securely locked against accidental or other movement from a distance, and can be maintained until released by the proper person. The first claim reads: "The combination, with a rail and a bar and a bolt for securing the same, of a lock for the bolt, a magnet for operating the lock to secure the bolt, a separate magnet to release the bolt, and a circuit changer connected with and automatically operated by the lock, and a signal for the train controlled by the circuit changer."

387,382. Electric Railway System. David G. Weems, Baltimore, Md.

Claims 1 and 2 are given: "1. In an electric railway system for transporting mail, express packages, etc., a train or series of cars provided with folding or collapsible wings adapted to be automatically thrown out laterally to resist the movement of the train.

"2. In an electric railway system, a series of cars provided with pivoted wings, automatic holding devices, and pivoted levers, in combination with fixed stops on the road adapted to engage said levers and release the holding devices, whereby the wings may be thrown outward by the action of the air."

387,383. Electric Railway System. David G. Weems, Baltimore, Md.

387,432. Armature for Dynamo Electric Machines. Alexander W. Meston, St. Louis, Mo.

The first, fourth and last claims are given:

"1. A flat ring armature composed of laminated sections, having one or more coils of wire wound on each section, any of such sections being detachable, said sections composed of alternate long and short plates fitted and joined together by means of the tongues and recesses formed thereby

"4. A flat ring armature composed of laminated sections, the laminæ thereof being insulated from each other, having one or more coils of wire wound around each section, any of such sections being detachable, said sections fitting and joined together by tongues and recesses, in combination with a spider and detachable magnetic pole pieces.

"17. The combination in an armature, of laminated core sections, two independent or separate spiders and two independent sets of laminated pole pieces which connect the opposite sides of the core sections with their respective spiders."

387,461. Terminal Device for Varying Electric Resistances of Currents. Elihu Thomson, Lynn, Mass.

387,463. Electric Regulator. Joseph A. Vansant and Frank S. Anderson, Easton, Md.

Claim 1 is given:

"1. A current regulator consisting of a receptacle containing a powdered substance having a certain degree of conductivity, a circuit breaker inclosed in said receptacle, and a compressor for varying the pressure upon and the resulting density of said substance."

387,464. Regulator for Electric Currents. Joseph A. Vansant and Frank S. Anderson, Easton, Md.

387,467. Apparatus for Purifying Water. William Webster, jr., Lee Park, Lee, County of Kent, England.

387,505. Method of Measuring Electricity. George Forbes, London, England.

The invention consists in a novel method of utilizing the heating power of an electric current upon a conductor to produce evaporation of a liquid in a closed vessel, the liquid so evaporated being noted and serving to indicate the quantity of electricity passing through such conductor.

The claims are as follows:

"1. The herein described method of measuring electricity, consisting in passing the current to be measured through a conductor and thereby heating the same, evaporating a liquid by the aid of the heat so generated, and finally noting the amount of evaporation which has taken place as a measure of the quantity of electricity which has been passed through the conductor.

"2. The herein described method of measuring electricity, consisting in passing an electric current through a conductor arranged in proximity to a quantity of liquid, thereby heating said conductor and evaporating the liquid, then condensing said vaporized liquid in a second vessel, and finally measuring the amount of liquid so condensed."

387,526. Electric Switch James F. McElroy, Lansing, Mich.

387,585. Auxiliary Fire Alarm Apparatus. Walter J. Dudley, Everett, Mass.

387,610. Electrically Driven Car. Joseph Weis, Jersey City, N. J.

387,615. System of Combined Arc and Incandescent Electric Lights. Harold P. Brown, Chicago, Ill.

The invention relates to means of combining in a single circuit, supplied by one source of electric energy, one or more arc lights or other translating devices which require for their operation a high tension current with one or more incandescent lights or other translating devices which require a quantity current.

The 2d and 9th claims are given: "2. The combination of a main or high tension current circuit with a local or incandescent lamp circuit, two or more incandescent lamps or other translating devices arranged in parallel group in said local circuit, an electro motive device in said local circuit, a circuit controlling lever or device operated thereby, a shunt circuit, and a series of graduated resistances having connections with said shunt circuit operated by said circuit controlling lever or device.

"9. A system for operating on one circuit arc lamps and multiple arc groups of incandescent lamps, said system consisting in a suitable dynamo or electric current generator, an external or working circuit energized by said generator, arc lamps located in series upon said circuit, and one or more multiple arc groups of incandescent lamps connected in said circuit with a shunt connecting with said main or working circuit on each side of and around each group of incandescent lamps, and each shunt containing an automatically variable resistance for determining and governing the current operating said incandescent lamps."

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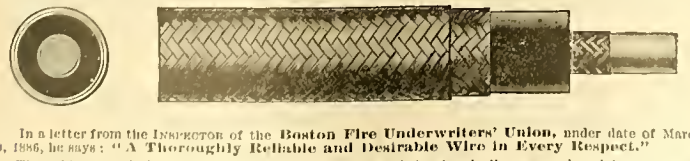

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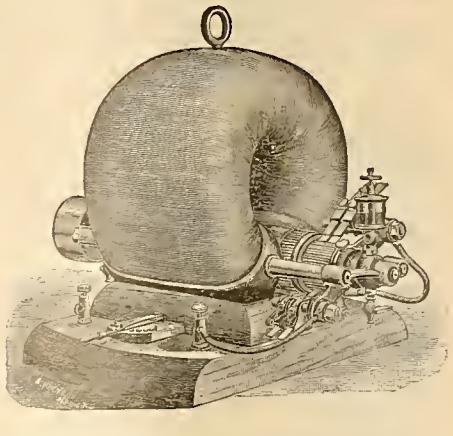

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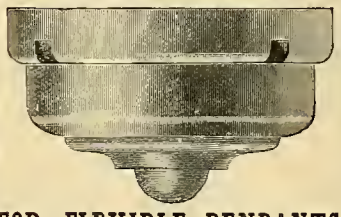
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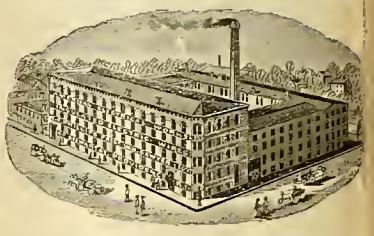
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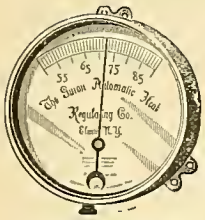

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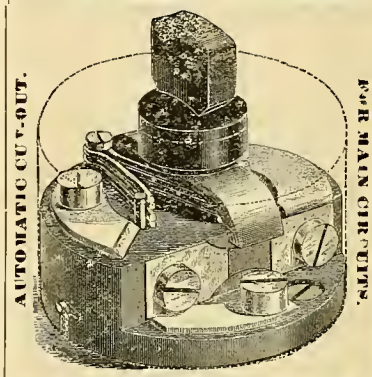

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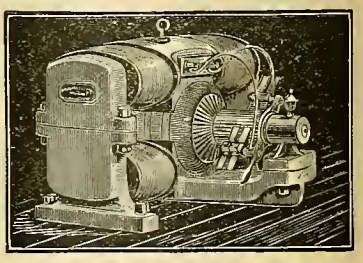
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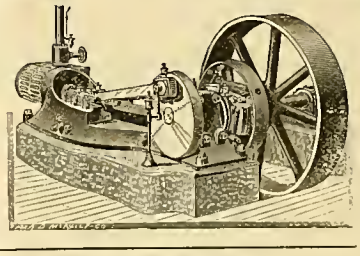

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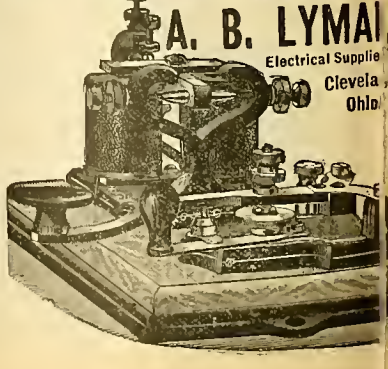

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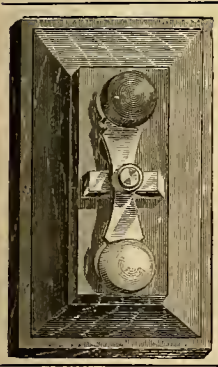

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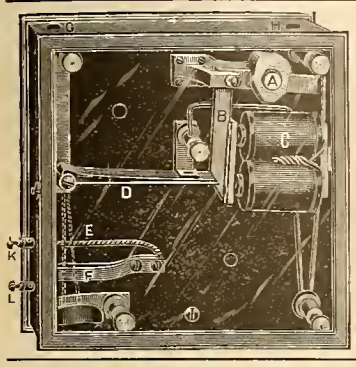

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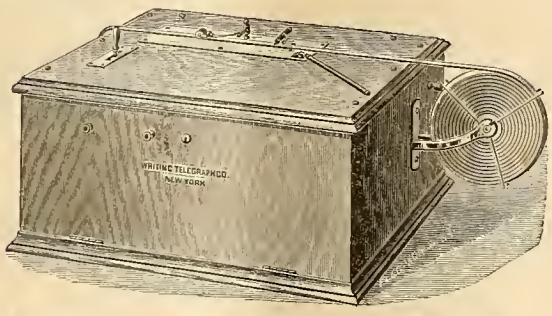

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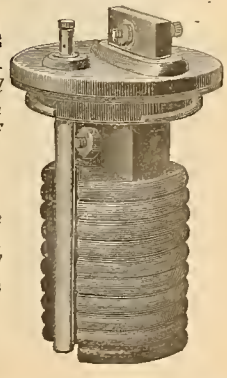

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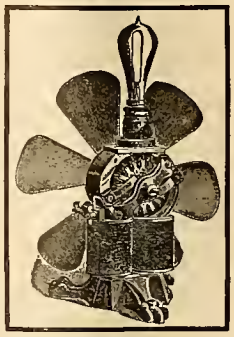

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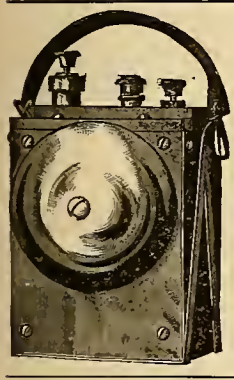

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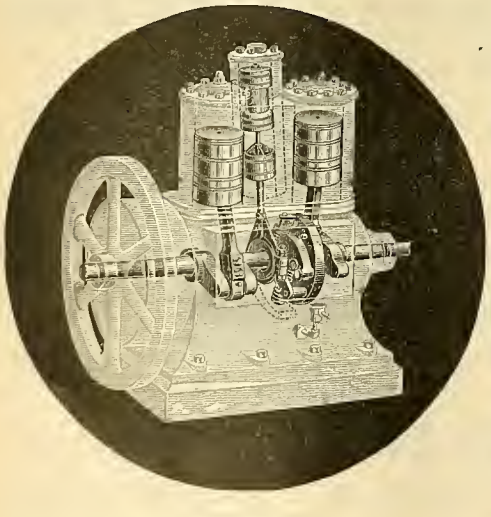

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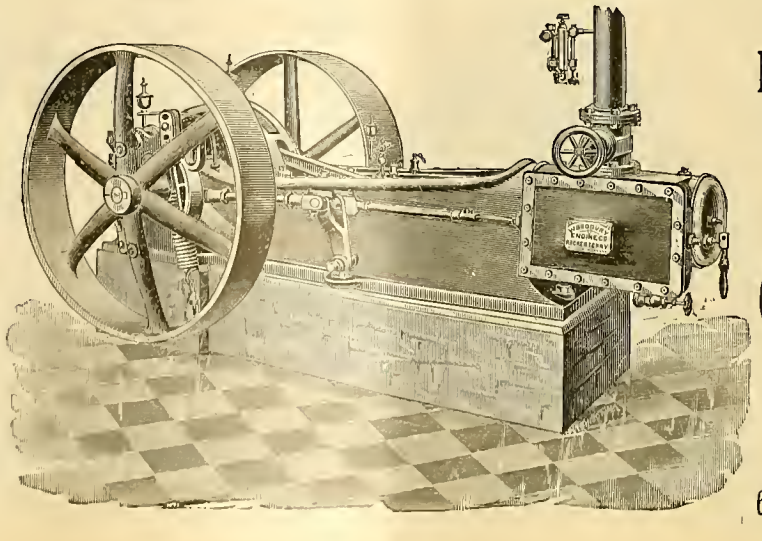

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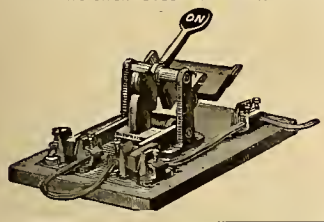

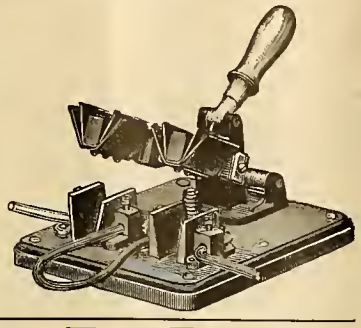

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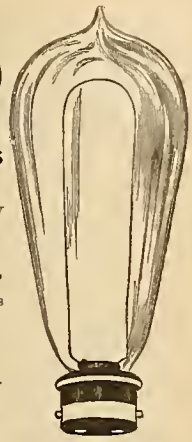

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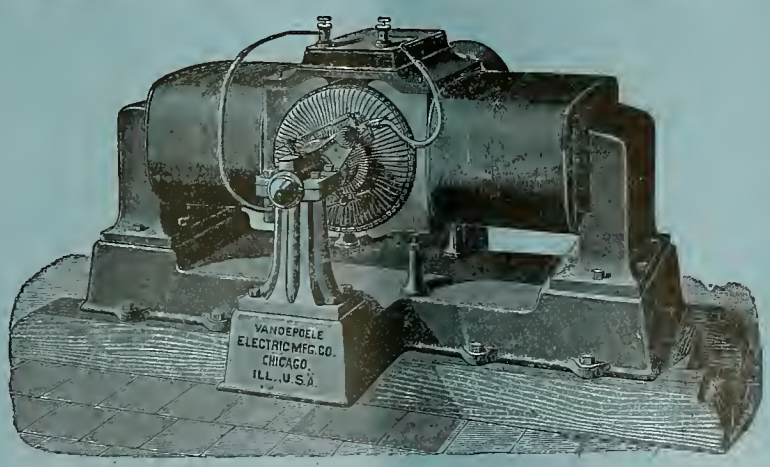

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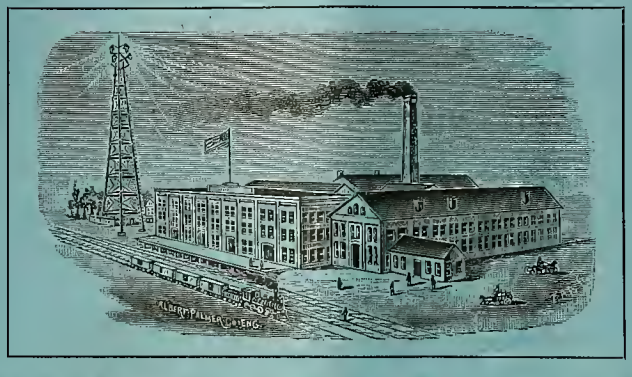

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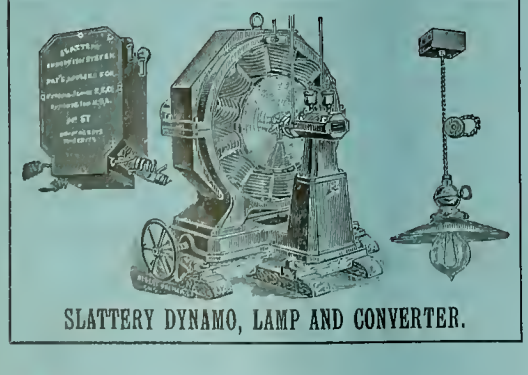

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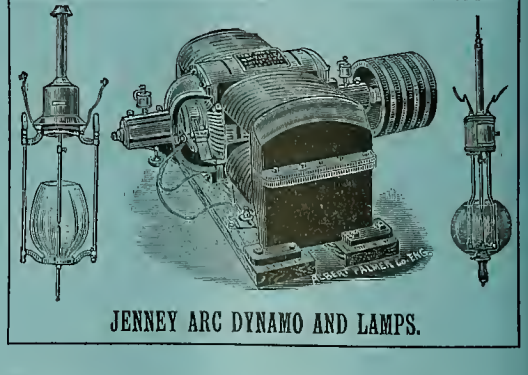

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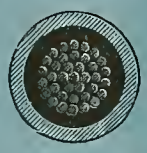

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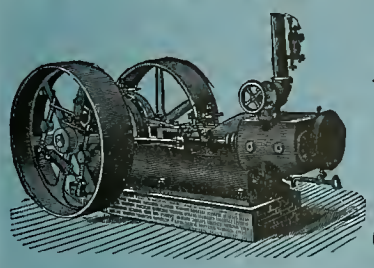

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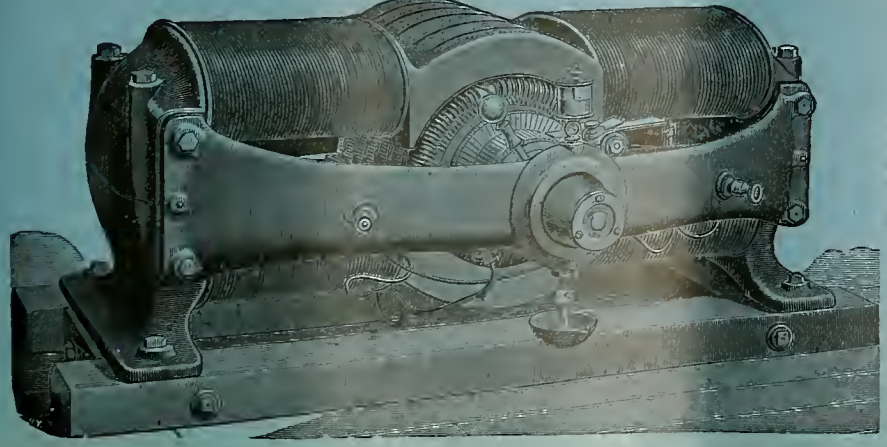

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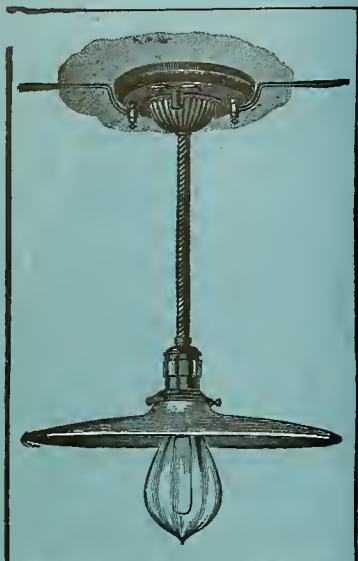

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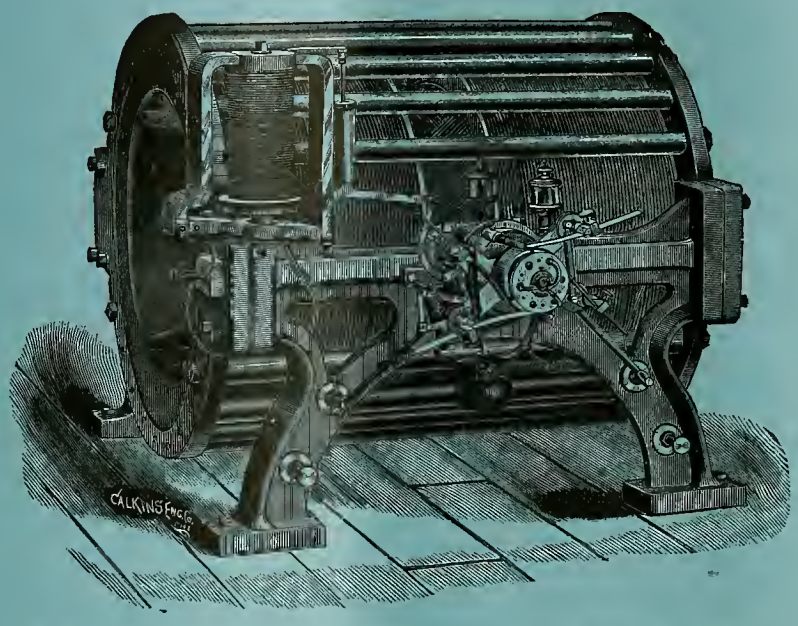

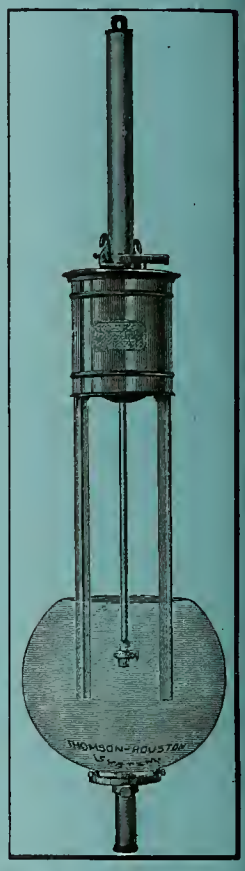

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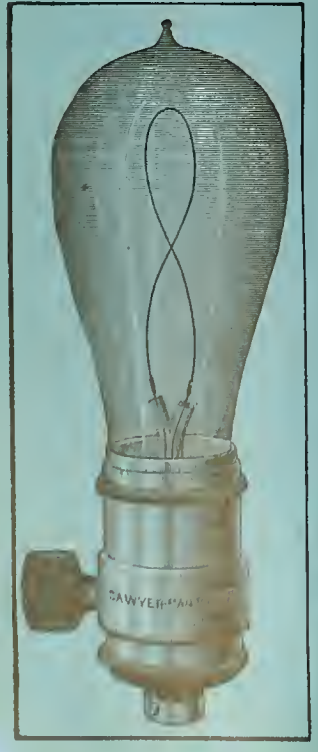

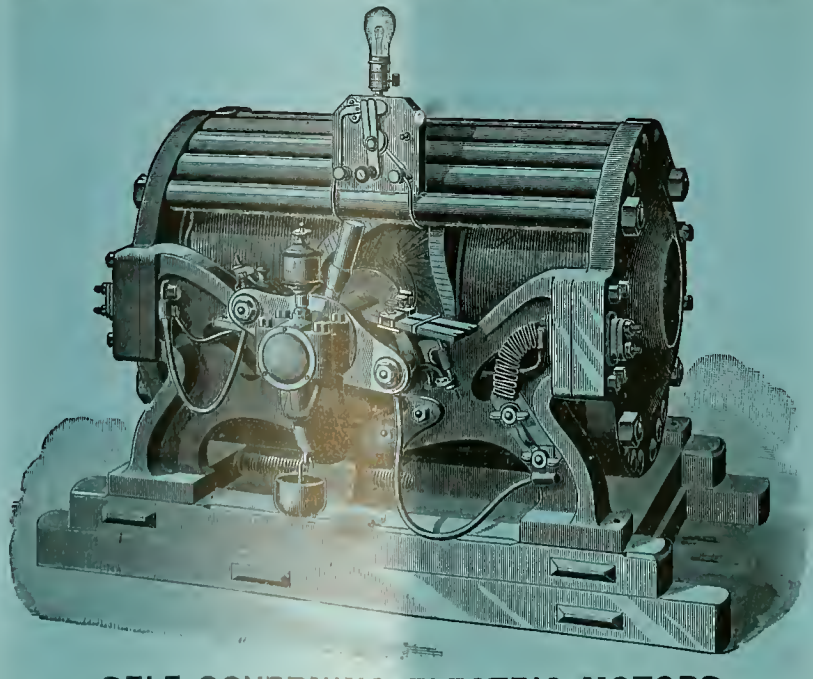

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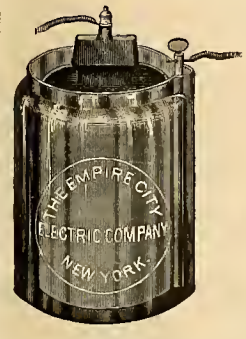

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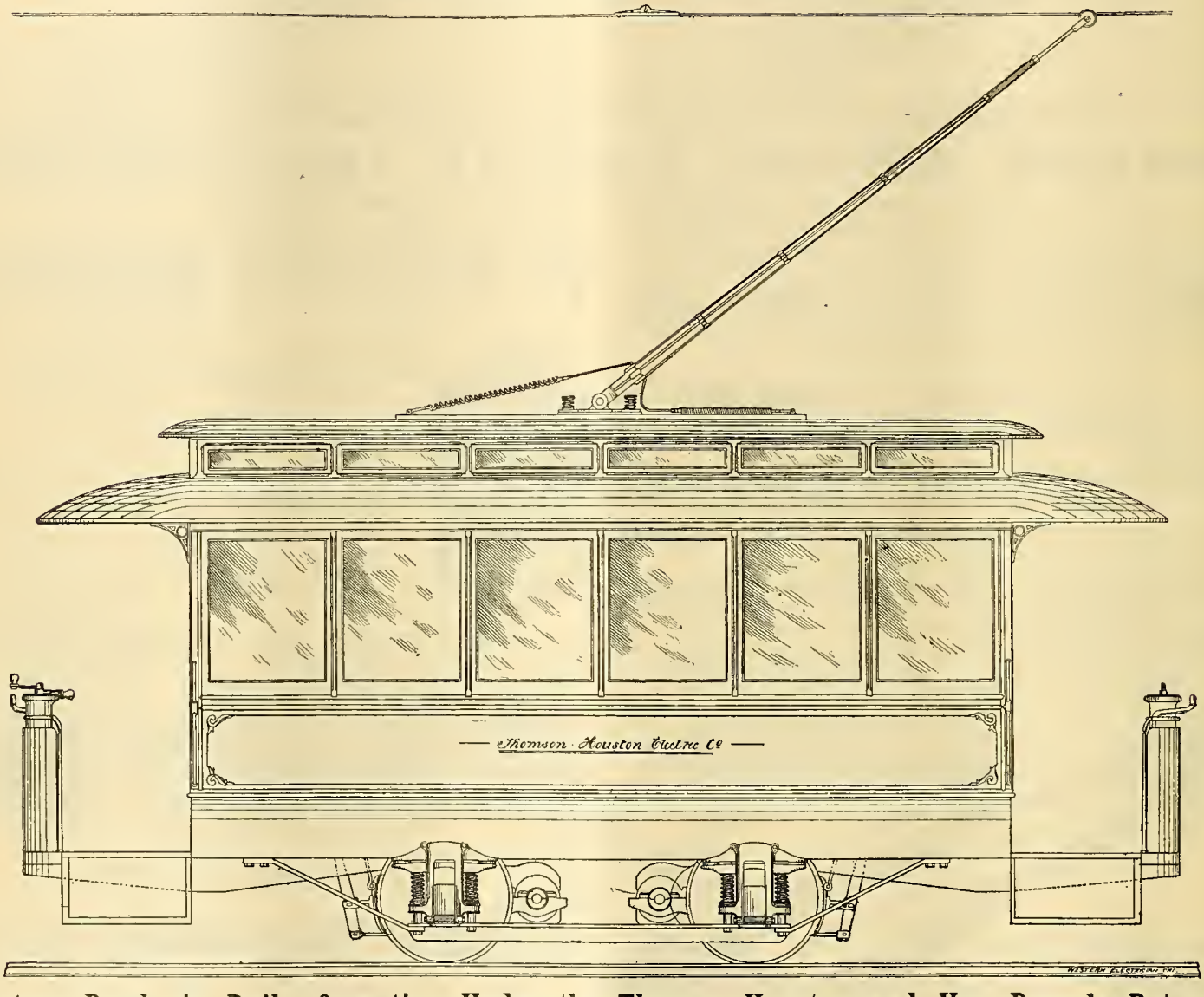

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Only one pair of brushes for each motor.

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No change of brushes for change of load or change in direction of rotation of the armature.

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The current is controlled, the car reversed, and the brakes applied from either platform.

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This system is made more profitable than any other by the use of the meter now supplied by this company.

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It is strictly a positive mechanical movement.

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This company has demonstrated that motors run by the alternating current are as efficient as the best direct current motors, and can be run without commutators or brushes, being started, stopped and reversed without breaking a connection.

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Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, AUGUST 25, 1888. No. 8.

Plant of the Electric Light and Gas Company of Woodland, Cal.

The cuts on this and the succeeding pages handsomely illustrate the well equipped central station of the Consolidated Electric Light Gas company of Woodland, Cal., one of the most prosperous companies on the Pacific coast. During the latter part of February, 1886, after the subject had been thoroughly investigated by local capitalists, the Woodland Electric Light Power company was incorporated with a capital stock of $10,000. An order for a dynamo of a capacity of 45 1200 candle power lights was given to the Thomson-Houston company. As sufficient capital was not subscribed to erect buildings, arrangements were made with a flouring mill to furnish dynamo room and power.

The first consignment of machinery had been in operation only a short time when it became imperative to order the full number of lamps for the capacity of the dynamo to supply. After the plant had been in operation about a year the capital stock was increased to $20,000, and the present building was erected, and the second dynamo with a full complement of lamps was ordered of the Thomson-Houston company. During the summer of 1887, the gas company, whose business had been seriously interfered with by the operations of the electric company made overtures for a consolidation of the two interests, which was finally effected, not as is usually the case, however, in such transactions, as the electric light company in this instance absorbed the gas company. At present the capital stock is $100,000.

From the cuts a clear idea of the arrangement of the plant can be obtained. The steam plant consists of an Armington & Sims engine 10 inches by 12 inches, boilers 54 inches by 16 feet, with heater, injector and Worthington pump. The two dynamos have a capacity of 90 1200 candle power lamps. Of this number the city rents 15 for street illumination. The entire plant is now leased by O. I. Cheney, who pays the stockholders 1 per cent. per month on the total investment.

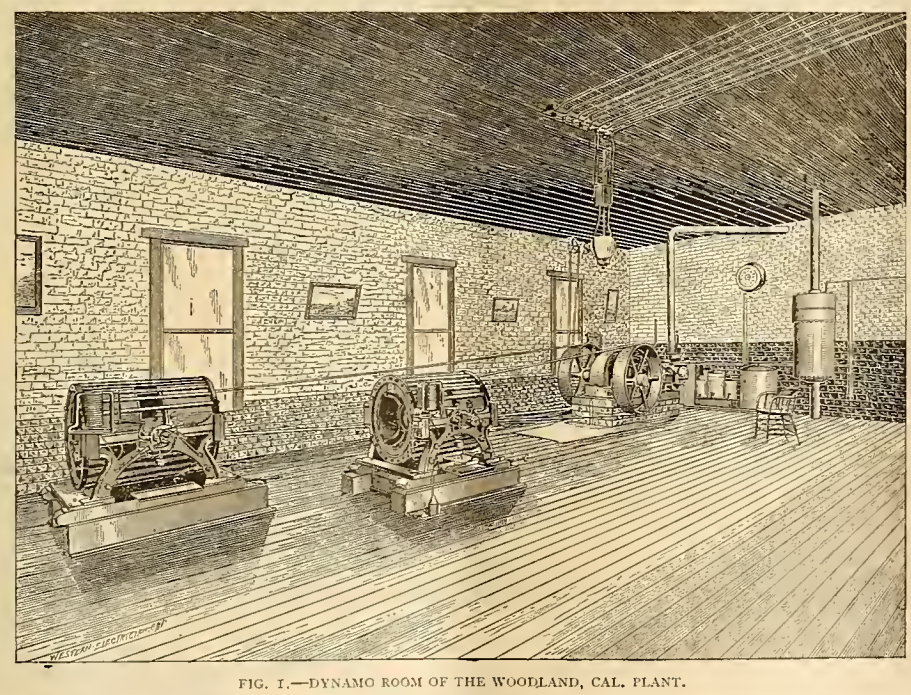


FIG. 1.—DYNAMO ROOM OF THE WOODLAND, CAL. PLANT.

Old Time Telegraphers.

The United States Military corps and the Old Time Telegraphers' association, which form practically one organization, held their annual sessions in Chicago August 15th and 16th. Many, if not most, of these old-time operators have long since abandoned their keys for other employment, but they remember the days when they handled the instruments with the greatest interest, and a considerable part of each gathering is devoted to comparing reminiscences. The session of the military telegraphers was held first. The organization is social in the main, but for years the association has been endeavoring to obtain from Congress some recognition of the important services which the members rendered during the rebellion. In 1884 Gen. Rosecrans introduced a bill in the house which recognized the value of the telegraphers' services, and made a provision for the payment of pensions. The bill was referred several times and was finally passed, with the exception of the pension provision. Finally it was sent to the senate, where the bill is now sleeping in a committee room.

W. R. Plum presided, and in his annual address spoke as follows in reference to the objects of the organization:

COMRADES:—It is twenty-three years since the rebellion. If we decide to make our reunions biennial, our next will be a quarter of a century from the din of war and clash of arms. We may then hope to jubilate over recognition. Heretofore, I have mainly argued the services and sufferings of the United States Military Telegraph corps of the late war, showing that without its aid the rebellion, if crushed at all, would have resisted much longer; that ours was the first practical demonstration of the telegraph for general and tactical war purposes; that in no former war were commanders so well advised of events and orders; that no corps was ever before so confided with army secrets; that its percentage of casualties in killed, wounded, captured and deaths was not much below that of other branches of the army; that for its service and sufferings the corps has been dismissed without thanks or honors. I strove to show that the 15,000 miles of telegraph connecting all of the armies with Washington, except those along the coast and below Memphis, connecting all the divisions of each army, even upon the battlefield itself, was the trusted courier of the Union forces in transmitting a yearly average of 1,300,000 military telegrams, largely in cipher, the keys to which were exclusively confided to telegraphers; I aimed to demonstrate our services in supplying and fighting an army, and in tapping the enemy's wires, as spies, and on raids, to prove that our armies have won victories and escaped defeat by our timely help, and raided the enemy's country with wonderful success owing to information stolen from rebel wire. In short, I assumed the burden of proof as to facts, and sought a verdict on the merits.

It was seventeen years after the war before any effort looking to congressional recognition was made In that time congress and history were as silent as the graves of our fallen comrades, concerning this new art in war and its volunteer devotees. Our officers were generaled and coloneled, while we were nothinged. That they deserved their honors only emphasizes the measure of ours unsung, and anomalizes our corps in the history of military affairs as the only one known where the officers were the sole recipients of a people's gratitude.

After a very careful inquiry into the subject in 1884, the house military committee, presided over by Gen. Rosecrans, unanimously reported a bill for passage, declaring us as a part of the Federal army, entitled to medals and the same rights as other officers of the army, and giving us relative rank according as our pay most nearly approximated that of commissioned officers, at the time of our discharge.

In the committee's report on this bill, among other things it said: "The reports of the secretary of war and the commanding general bear uniform testimony to their efficiency, intelligence and patriotism. Their duties were purely military, and were performed with the same exposure to the dangers of the field and disease as fell to the lot of the ordinary officer and soldier. They constituted an integral and vitally essential part of the army, and brought the system to a state of perfection never before equaled in military science. Their duties required the service of persons of peculiar intelligence, and its members were picked from the great number of operators on account of special prominence acquired in this mysterious art. Their duties were almost continuous, unrelieved by the excitements and relaxations of ordinary camp life. * * * The present bill gives to these deserving persons a military status merely. It places them upon the same footing as other members of the army, and accords to them at this late day the privilege of pension and homestead to which they are justly entitled."

The report which showed research was mainly readopted with the new bill approved by the house military committee of the 49th congress; that committee, while it eliminated some of the features of the former bill, adopted the most important ones, but owing to the pressure of other measures no action was taken. Again the matter was referred to the military committee of the 50th congress, which readopted the preamble of 1884 to its bill, in the main like that of Rosecrans' committee, except as to pensions. This bill was accompanied with an elaborate report from which I extract the following highly commendatory language:

"Until the late civil war, it is believed an army electric

telegraph corps was unknown. The use of the telegraph in war had been rarely attempted in Europe.

"In the exigencies of the early stages of our civil war the United States military telegraph corps was organized on a small scale, upon a quasi military basis, its principal commanders being regularly commissioned officers of the army, for the sole purpose of handling the corps; its operators were sworn into service, but not for any definite period, and, like all others of the corps, were carried on the quartermaster's rolls.

"The services performed by the corps, which increased with the necessities of the army, were of such importance and efficiency that every European nation, and our own government, have since reorganized their army systems so as to include an electric telegraph corps to perform precisely the same telegraph duties that were required of the United States military telegraph corps in question. In addition to their strictly military telegraph service the operators were, especially in the latter years of the war, the custodians of all cipher keys, and required to put into cipher and translate all important dispatches, and thus they became and continued throughout the war, most confidential and trusted aids, engaged in the courier service, transmitting about 6,000,000 dispatches. This corps, consisting of about 1,200 operators and a sufficient force of line men, built and operated 15,389 miles of telegraph lines for military purposes, including 1,000 miles of field wires, which latter were ofttimes worked on the field of battle and under a heavy fire. Of this corps Secretary Stanton officially reported 'that the military telegraph has been of inestimable value to the service, and no corps has surpassed, few have equaled, the telegraph operator in diligence and devotion to duty.' General Sherman, since the war, wrote: 'The greater number were distributed along the lines, had to work day and night, and were as much a part of the army as though armed with muskets in the ranks; for before the discovery of the magnetic telegraph, the sending of messages back and forth, to and fro, was always done by armed cavalry messengers and escorts, consuming a large portion of active army. In fact, there should have been, in civil war, a regular corps of telegraph operators, with regular muster-rolls, so that the wounded and disabled could be entitled to the same pension as other staff soldiers and officers.'"

The president quoted other generals who praised the zeal and efficiency of the corps, and concluded as follows:

In the senate a bill as good as that of 1884, except as to pensions, was reported in 1887, and re-adopted in 1888, but not yet reported. It will thus be observed that our claims have been five times favorably considered by congressional committees on military affairs, and not once rejected. Whenever pension provisions have been struck out, there were not wanting able advocates who were ready and willing in either house to press them, but to avoid the appearance of seeking pecuniary gain and silence those who cavil at all pensions, since 1886 no effort has been made by your committee regarding either pensions or bounties, though the Hon. Mr. Brewer, M. C., early in the present session introduced a bill for that purpose. Thus, my comrades, though it be a case of hope deferred, making the heart sick, our cause has steadily advanced, and in time will certainly be successful, provided you be not discouraged, and make reasonable provision for necessary expenses.

The association voted to send a message of sympathy to Mrs. Sheridan. The election of officers resulted as follows: President, W. R. Plum, Chicago; vice president, George C. Maynard, Washington; secretary and treasurer, James E. Pettit, Chicago.

The Old Time Telegraphers' association convened August 16th. The organization includes in its membership those who were operators during the first twenty-five years of the history of the telegraph. The society has for its object the preservation of all records relating to the early years of the telegraph. The members are full of reminiscences and they enjoy so thoroughly these opportunities to recall old days that it is difficult to call them away from their social conferences to the less fascinating business sessions. Irwin Dugan of Louisville, Ky., took the chair in the absence of the president, David Brooks of Philadelphia, who was unable to attend. Mr. Dugan briefly congratulated the association on the interest manifested in the gathering, and spoke of the success which had characterized the history of the association. It was voted to hold the next annual meeting of the association at Louisville the third Wednesday and Thursday of September, 1889.

It was voted that the secretary should collect from the old timers all records, photographs and mementoes which would form interesting contributions to a history of the pioneer telegraph. The election of officers resulted as follows:

President, Charles E. Taylor, Frankfort, Ky.
Vice-President, Day K. Smith, Kansas City, Mo.
Secretary and Treasurer, W. J. Dealy, New York.
Executive Committee, R. J. Hutchinson, New York; S. B. Fairchild, St. Louis: J. M. Turner, New Orleans; Uriah B. Wilson, Denver, and the officers ex officio.

After adjournment the members under the leadership of A. H. Bliss visited the board of trade. In the afternoon the old timers boarded the steamer Josie Davison and enjoyed a ride on Lake Michigan.

The two societies held their annual banquet at Kinsley's. A merrier party never assembled in a supper room. Stories relating to experiences of a quarter of a century ago were heard on every hand, and the hall resounded with laughter throughout the evening. The evening's exercises were opened with prayer by J. D. Reid of New York. After a solo by Mrs. E. M. Tomlinson, W. R. Plum of Chicago, who acted as toastmaster, rapped for order. He read letters of regret from Charles T. Smith of Louisville, W. B. Mason of Philadelphia, S. T. Armstrong of Tacoma, W. T., William Barr of Washington, and others. J. D. Reid of New York was called upon to respond to the toast, "Prof. Morse, God gave him to us and after he fulfilled his noble mission God has taken him away."

In commencing his toast Mr. Reid said it was one of the proudest occasions of his life when he could speak of Prof. Morse, with whom he had been associated. He was a man of whom he sometimes thought the world was not worthy. Mr. Reid turned his attention to the refutation of statements contained in an article on Prof. Morse which had appeared in a Chicago paper. He said the efforts which had been made to depreciate the work of the great inventor contained the greatest misrepresentations. The speaker referred to Mr. Vail's assistance in Prof. Morse's work and said it was merely that of a skillful mechanic. Prof. Morse was not a mechanic, but Mr. Vail put the ideas which were given him into shape. He made the first register, for example, but it was a clumsy looking affair. In fact, the speaker said, he claimed for himself the credit of designing the first register of artistic shape. So Mr. Vail deserved the credit as a skillful mechanic and a faithful friend. They were associated in a grand work, and they accomplished it.

"Men may try to take the crown from his head," continued Mr. Reid, "but it will remain there forever. As long as I have a heart and a voice I shall defend my friend. His name will go down to posterity as the only inventor of the telegraph which bears his name."

John B. Taltavall of New York responded to the toast, "The Ladies," in a happy manner.

A. H. Bliss of Chicago was called upon to speak to the sentiment, "The Army Telegrapher, first in war, first in peace, and last in the hearts of his countrymen.'

The toast "The Boys" was assigned to W. L. Ives of New York. He conveyed to the association the greeting of the New York comrades, and spoke at length of the significance of the reunions, of the pleasure of renewing friendships formed a quarter of a century ago under trying circumstances.

Col. R. C. Clowry was called upon and simply expressed his pleasure at being present, and said he hoped the members had thoroughly enjoyed their visit to Chicago.

The following committee was in charge of the banquet: A. H. Bliss, S. L. Robinson, G. W. Farnham, E. P. Whitford, A. C. Knapp, A. L. Suesman, A. W. Nohe, C. S. Jones, and C. H. Summers.

The following were in attendance at the banquet: Col. and Mrs. R. C. Clowry, Mr. and Mrs. A. H. Bliss, Mr. and Mrs. Charles Wright, Mr. and Mrs. D. S. Anderson, Mr. and Mrs. E. P. Whitford, Mr. and Mrs. H. W. Plum, Mr. and Mrs. W. R. Plum, Mrs. J. W. Atwell and Miss Atwell, Mr. and Mrs. C. S. Jones, G. W. Huddleston, J. W. Davidson, E. L. Powers, J. N. Crittenton, Walter Stevely, Arthur Cambridge, J. E. Pettit, S. C. Mason, S. L. Robinson, W. J. Lloyd, A. J. Mitchell, Anson Gorton, A. W. Nohe, Thad Schnell, Miss Madge Bain, Miss Katherine Knight of Chicago; W. J. Dealy, J. D. Reid, John Brant, R. G. Stephenson, Theodore Tullon, Joseph Knittle, R. J. Hutchinson, Theodore L. W. Finnegan, L. S. Jones, William Leonidas Ives, John B. Taltavall, Mr. and Mrs. E. M. Tomlinson, Frank Brassell of New York; Alf Weller, Milwaukee; Wiley Smith, Indianapolis; K. McKenzie, George W. Dugan, Jackson, Tenn; Ben Lloyd, Pittsburg, J. D. Voltz, Cowan, Tenn.; J. D. Cruise, W. H. Woodring, Kansas City; R. W. Dugan, Covington, Ky.; Mr. and Mrs. J. M. Turner, W. D. West, New Orleans; W. W. Kelchner, Springfield; Lee N. Boath, Riverdale, Mich.; Syd Fairchild, Charles Newton, St. Louis; R. A. Taylor, Ed Norcross, R. B. Woolsey, Terre Haute; Col. C. E. Taylor, Frankfort, Ky.; D. K. Smith, Kansas City; George C. Maynard, Washington; Irwin Dugan, Louisville; Phil Bruner Wellsville, O.; H. C. Vincent, Marietta, O.; Dr. H. L. Pease, Grand Crossing; E. Rosewater, Omaha.

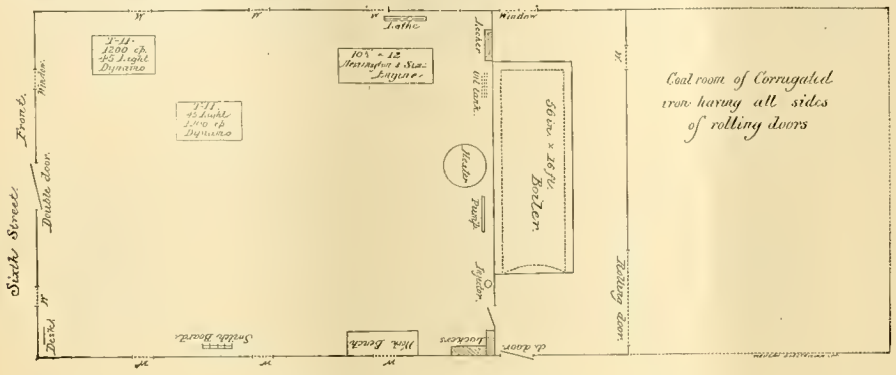
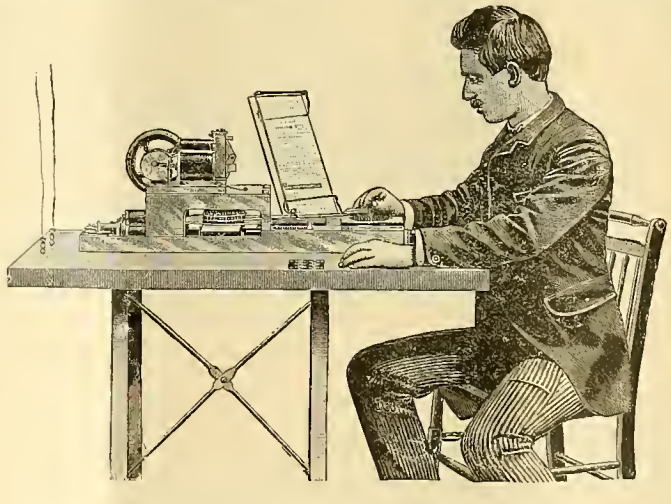


FIG. 2.—GROUND PLANT OF THE WOODLAND CAL., PLANT.



ELECTRICAL MATRIX MAKING MACHINE.

Electrical Matrix-Making Machine.

In No. 5, Vol. II, of the WESTERN ELECTRICIAN a brief description was given of an electrical matrix-making machine, designed for use in printing offices. C. L. Redfield, editor of *Wood and Iron*, has been engaged in the development of this machine for some time. In manipulating the machine a specially prepared card board or matrix board is used, into which the impressions are made successively by dies forced downward semi-electrically. The size and form of the machine are well represented by the cut on opposite page.

The dies, ninety in number, are carried between two thin plates and are shown in the interior part of the machine. The lower one of these plates is extended out into a long thin lever which is pivoted near the middle of its length to a sliding cross-head, and has its one key at the other end. It will be seen that by taking hold of the key the dies may be made to slide around into any position. Directly below the key is a hard rubber index plate with ninety-one holes. These holes, which are made to accurately fit the pin projecting below the key, form the guide whereby any die desired can be brought to the center of the machine.

On top of the machine is a crank driven by the soft iron armature and draw the toggle joint straight. The lower end of the toggle is provided with a punch or sliding hammer which drives the die down into the matrix below. As the toggle passes the center, it comes in contact with a pin and breaks the circuit so as to leave the armature free to stay in its outer position where the reciprocating core pushes it on its return stroke. By this means the hammer makes but one stroke, no matter how long the key is down, and this is finished and hammer returned to its former position in less than one-fifth of a second from the instant of first contact of the key. It should be remembered that the current that connects the hammer movement, frees the escapement on its way, and no matter how quickly the hammer stroke is made, it is always preceded by the proper amount of movement of the matrix carriage.

The width of the column to be printed is divided into a certain number of units of space, these units being the ones on which the letters are cut. A little in front of the center of the machine and by the side of the sliding cross-head is a scale of units in which is registered the position of the carriage at any moment. The carriage is further provided with a false frame by which the matrix can be drawn out and inspected, and then returned to its former position without endangering the adjustment. The carriage escapes from the operator and is returned to the beginning of the line by pulling back on the pin just over the unit scale. The distance between lines can be anything desired, and is made by pressing a button on the side of the matrix carriage.

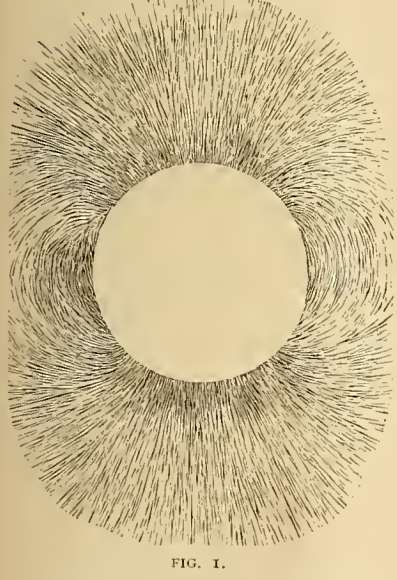


FIG. 1.

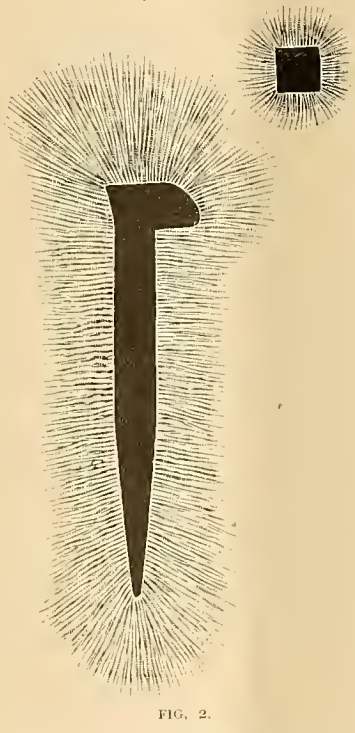


FIG. 2.

belt, and is the only power application. Driven by this crank is a long reciprocating piston, or magnet core of soft iron, which is within the larger of the two upper magnets. Just in front of this magnet is a toggle joint to which is attached a soft iron armature extending a little ways within the magnet. Beneath the steel plate on which the dies slide, and through which there is a central perforation for the dies to pass, is a matrix carriage extending across the machine. This carriage has a movement lengthwise of the machine, a distance equal to the width of column to be printed. This movement is produced by means of a clock spring, and the amount of movement is controlled by an escapement at the extreme back of the machine. All the letters and characters are made in one of the six different sizes, hence there are six different amounts of escapement, each of which is a multiple of the smallest.

When in operation the crank is kept running and the soft iron core reciprocates in the large upper magnet at about 300 revolutions per minute. When a letter is to be struck the key is pressed into one of the holes in the index plate, where it makes an electrical connection which gives the proper escapement for the letter struck. The same current that frees the escapement passes through the large magnet and causes the reciprocating core to cling tightly to

All copy for this machine is prepared on a type writer, and the amount that goes to make a line is determined by a justifying machine which is attached, electrically, to a common type writer. This machine is but a slight modification of the escapement movement of the matrix machine, and is now being designed in the office of *Wood and Iron*.

The actual rate of work that can be accomplished on this machine is not known, as there are yet no expert operators, but a non-expert can, after an hour's practice, easily make 5,000 ems per hour, which is four or five times the amount of work performed by an ordinary type setter. The machine, however, is not adapted for display type, and can be used to advantage only on body work.

The Brainerd, Minn., Electric Light, Heat & Power company, has ordered 2,000 lights of the alternating system of the Fort Wayne Jenney Electric Light company, through Walter K. Freeman.

Magnetism in Watches.[1]

By C. K. GILES.

In introducing the subject, Mr. Giles enumerated a series of questions that had been propounded relative to the variation in watches, and then considered the effect of magnetism, bringing forth some novel ideas and striking illustrations. A summary of his paper follows:

First, let us investigate the general conditions and lines of force with which we have to contend. This condition, called magnetism, exists everywhere; it is the primary law, the ultimate fact; it is "inter-etheric and cosmic," and exists throughout matter and space—it is the dual force of nature, *at rest*. The normal condition of the molecules of all matter is one of polarity, generally called positive and negative. Magnetism, as it exists in matter, is only a condition, and the directive force of this condition in the molecules of matter, or atmosphere, or ether, is polarity, and this polarity creates, or is itself, the line of force, and the intensity of this polarity is the strength of these lines of force, and the inter-etheric nature of this force extends it through more solid matter, as well as atmosphere. The molecule is the resting place of this dual electro-magnetic force; every molecule of the atmosphere is divided into its own individual dual polarity, and arranges itself according to its neighbor; the mass of the molecules will arrange its polarity according to existing conditions. The earth is the great primary magnet, and gives us the normal condition and direction of polarity existing in matter; any disturbance of this normal condition gives us the phenomena of magnetic or electric effect. Scientists at present agree upon the molecular or atomic theory, and the latest estimate we have seen is that a cubic inch of atmosphere contains from 60,000,000 to 100,000,000 molecules; the same sized mass of brass is estimated to contain one-half this number, and so on. This electric or magnetic force exists in dual form, positive and negative, and must be in equilibrium; any disturbance of this equilibrium results in some form of phenomena—the permanent displacement or annihilation of this dual condition of electricity or magnetism would be equal to creating a vacuum in the atmosphere—neither one or the other can be fully accomplished. All moving electric currents and magnetic conditions are looking for satisfaction—seeking their equilibrium, as water seeks its level; if this equilibrium is not found in the atmosphere or matter surrounding the earth, it is sure to be found in the earth—the earth is the

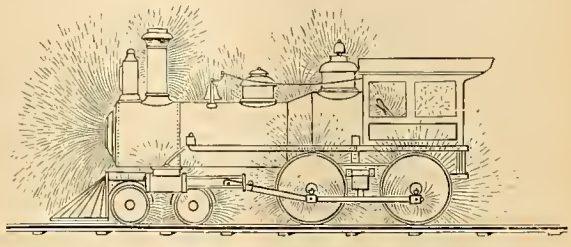


FIG. 3.

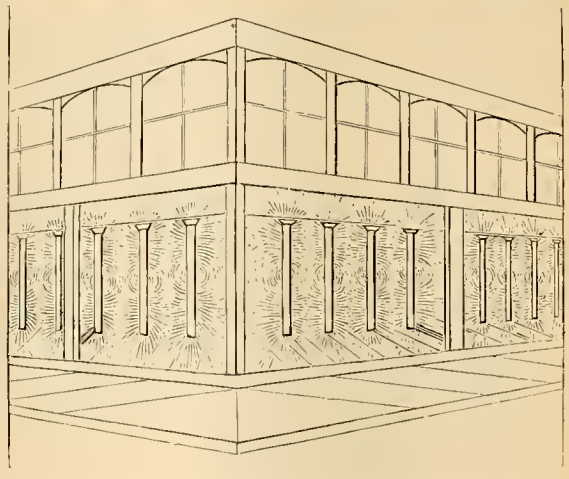


FIG. 4.

[1] Abstract of a paper read before the American Railway Master Mechanics' association at Alexandria Bay, New York, June 19, 1888.

great clearing house of the disturbed equilibrium of the dual conditions. Our globe represents the aggregate polarities of all the molecules composing it, and as a mass it must be in a condition of equalized polarity. The movement of electric currents and magnetic conditions about the earth is but the means of the disturbed dual polar force to keep up the equilibrium of the whole. Electricity is the primary cause of the condition called magnetism. A bar of steel whose molecules have been put in a condition of intense polarity become a magnet; a piece of tempered steel whose molecules are so compact

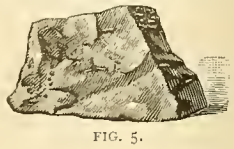


FIG. 5.

that they are not free to move, and cannot rearrange themselves satisfactorily with the normal atmospheric polarity, becomes what is called a permanent magnet, and will create a magnetic condition equal in intensity to its own, in the molecules of atmosphere or other matter which impinge on its surface. It would appear, then, that the strength of magnetism, or magnetic lines of force, is the inertia of the molecules forming the magnetic center. When this is overcome by an influence stronger than its own, the polarities change, but not until then. To make visible the lines of force, and magnetic conditions which we have to contend with in rating our watches, as well as in running a railroad, we have made some photographs of actual conditions existing, as shown by experiments, which explain some phenomena otherwise unexplainable.

We show in Fig. 1 a wheel, or disk of steel,

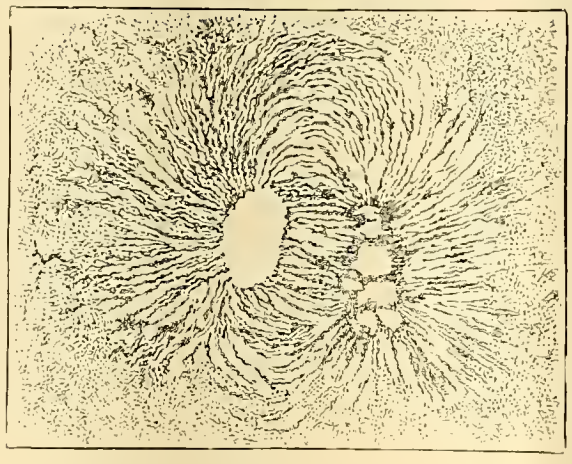


FIG. 6.

magnetized, the iron filings on the card board showing the lines of force, the two poles and the equator of the forces; this may represent a single molecule, or an aggregation of molecules, or the earth—as the law which governs the single molecule is the same as that which governs the whole—nature's law of force does not recognize size; the entity of force is in the molecule; everything else is but the aggregation of molecules the same as the individuals make the army; and the equilibrium of force must exist in any aggregation of molecules, the same as in the single molecule. Let this set of conditions represent the earth and its atmosphere; you will notice its poles and the equator of the forces, and the lines of force existing in the atmosphere, in natural equilibrium. If we take this little compass needle and pass it around the circumference of the disk, you will notice that its positions correspond with the lines of force as shown by the iron filings, and also with the record which navigators have given us of their dipping needle when sailing around the earth; on the equator it rests level; as we move it toward the pole there is a regular degree of incline to every degree of latitude; at the pole it stands perpendicular (navigators are not able to reach the point where the needle stands perpendicular, but the other records are the same, of course allowance being made for the local disturbances); as we pass the poles the incline is in the same degree until we reach the opposite side, where it rests level on the equator again, and so on to the starting point. This will make visible to you the cause of the phenomena of the changing polarity of a piece of iron as we change its position as regards the earth—the iron being magnetic itself, the direction of its polarity will be subject to the same lines of force as the compass needle—the jarring of the iron simply assists in overcoming the inertia of its molecules, so that they more completely fall into the directive force—this also shows the lines of force to which all moving matter on the face of the earth is subjected, our watches included. These atmospheric lines of force are utilized by Edison in train telegraphy; and again, these invisible lines cause practical electricians the serious trouble which they call induction. Every piece of iron or steel creates around itself a magnetic field or halo of force, caused by the magnetic condition of its molecules being more intense than the normal atmosphere. Every molecule of iron is but a small magnet, and the aggregation of these is the bar magnet, and its condition can be made more or less intense by manipulating it with more or less electricity.

The illustration, representing a railway spike Fig. 2, will show the halo of force which surrounds any piece of iron or steel—it is popularly understood, or generally expressed, that any piece of iron receives or owes its magnetic condition to an induced charge of magnetism from the earth. This is not a fact—all iron is magnetic per se, and receives no more induced charge from the earth, than the compass needle does from the north pole—the general magnetic conditions existing in the atmosphere surrounding the earth give direction to its polarity, but the lines of force, or condition, extend outward from the iron until equalized in its surroundings, just as the waves in still water circle outward when a stone is thrown in.

Fig. 3 shows an outline of the general magnetic conditions which surround the locomotive.

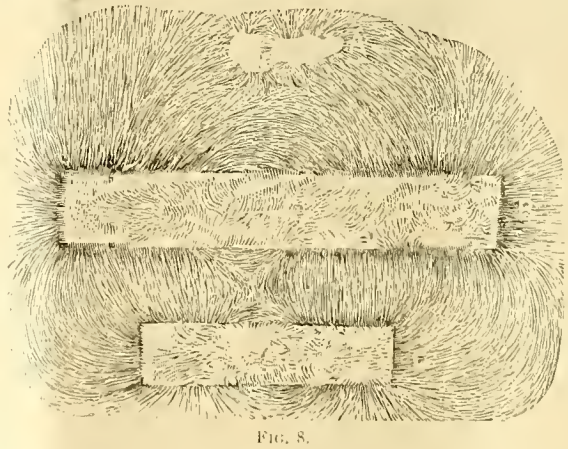


FIG. 8.

These lines of force will be made more tense by the electricity evolved by the swift moving locomotive cutting lines of earth's force, as seen in the previous sketch, the effect of which, on a small scale, is the same as the dynamo; but there is less permanent magnetism in the locomotive of the than in the of the train, on account the heat of the boiler, but there is more of electro-magnetic conditions, and more of the rapidly changing polarities.

Fig. 4 again shows lines of force in any iron building, or buildings with iron columns; you will notice the two poles and the equator of force in each column, also between any two columns. This is easily proven, and shown to be practically correct by any simple magnetic field searcher,—a compass needle; a dipping-needle,

FIG. 7.

or even a fine cambric needle magnetized, and floating on a glass of water, will show the horizontal direction of the lines of force in any set of conditions; it is generally understood that the north end of the compass needle will be deflected toward any iron body, but as a matter of fact, the attraction depends on the position of the needle relative to the iron body; the upper half of any piece of iron will attract the north, and the lower half the south end of the compass needle. This compass needle and this piece of iron (a spike) will show this,—we will first test for permanent magnetism. The scientific test for permanent magnetism in a piece of iron is to lay it over the center of the needle, holding it perfectly level and keeping the bulk of the metal equally distant from either pole; if it does not deflect the needle it is free from permanent magnetism, as you see it now—we hold it perpendicularly, and approach the lower end of the compass needle, and it immediately responds with its south pole—we reverse the iron, end for end, and we have the same action. Now we raise the needle slowly along the perpendicular iron, and, as we pass the center, the needle will begin to reverse, and at the top the south end is repelled, and the north end attracted. We change the molecular arrangement of a piece of iron by holding it perpendicularly and striking it gently, but hard enough to disturb the inertia of its molecules, which allows the earth's directive force to assert itself; now, putting it level over the needle as before, we will see the needle move to meet new arrangements of force in the spike, the south end of the needle will meet the end of the spike which was down when struck. Now hold the spike level, striking it gently as before, and replace it

over the needle, and you will see the needle is undisturbed. We have rearranged the molecular, magnetic conditions in this spike, and you will see that we can manipulate this magnetic arrangement of molecules, as we would a tangible, physical body, and this change and rearrangement of molecules is taking place in all iron when its position is changed as regards the earth, with the consequent tendency of the molecules to group around any given magnetic center, or any hard spot, or any condition more compact than the average of the mass. In these hard spots the molecules, being more compact, are not free to rearrange themselves, therefore they hold their magnetic conditions, and form a

FIG. 9.

magnetic center for the more free molecules, and in actual work, the intensity of this condition will increase with use, and might result in what is generally known as crystalization.

Fig. 5 shows a natural magnet—a piece of magnetic ore,—this might represent a magnetic center, a crystallized spot, a hard spot in iron, and causes a crystallized space, or hard spot, or magnetic center, in the atmosphere. We place a card board with iron filings over this ore, and gently jar it, when it will show exactly how the lines of force are formed in the atmosphere surrounding it.

Fig. 6. This is only a section of the force which is extended around in all directions, as in all magnetic conditions, and probably accurately

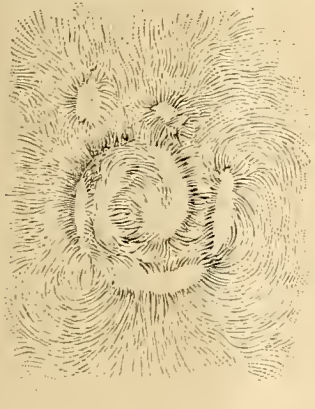


FIG. 10.

represents the first step of formation, ending in crystallization in manufactured iron and steel. You will notice that these iron filings are held together by these magnetic conditions—you will have to use considerable force to break them,—this is magnetic life, or magnetic cohesion, or a natural crystalline fiber, if you will allow the term.

Fig. 7 is the same card board and iron filings, with the natural magnet removed, and the card board slightly jarred, and as a result you will notice that the curved lines have lost their magnetic cohesion, and have become granulated; and when this occurs in a piece of iron or steel, it becomes what is called rotten, and there will be a breakage when any extra strain is encountered.

Fig. 8 shows three pieces of steel arranged side by side with the card board and iron filings, and exhibits the grain of the steel and also the several polarities or magnetic centers, or hard spots in a single piece of steel also shows the lines of force between the pieces. A, is from a square piece, but the polarities are so intense as to destroy the outline of its form—it is a very brittle piece and will break on slight provocation.

Fig. 9 shows the magnetic condition in and around an ordinary file, which also is brittle, breaking with a light blow.

Fig. 10 is obtained with the card-board and iron filings over a piece of a watch mainspring which was broken during the late electrical atmospheric disturbances. There is a striking similarity of magnetic centers, or hard spots, in this piece of mainspring, to those shown in the bar magnet, or file, and which are about the same as would occur if the steel in Fig. 9 was rolled out to form this ribbon of metal, the mainspring, carrying the inequalities throughout the length of the spring. The whole length of the mainspring is similarly formed to the piece shown, and as it is closely coiled in the watch during service, and these antagonistic polarities come in juxtaposition as the coils pass each other, as the watch runs down, which, taken in connection with the right electric, or magnetic and thermic conditions in the atmosphere, apparently causes a completion of the forming or crystallizing conditions, and the amorphous matter between any two magnetic centers will group with, or combine with, one or the other of these magnetic nuclei, causing a lack of cohesion on the dividing line, and under the strain of service there is a parting, and we have a broken mainspring. Mainsprings, when lying in stock, are never, or very seldom, broken; it occurs only when in action. Thus we have a partial explanation of broken mainsprings in connection with electric storms. We are making further researches and experiments, which we trust will more definitely develop this interesting subject,—but experience in the past four or five years has shown that surrounding the movement with a shield circle of highly magnetic metal will prevent fully seventy-five per cent. of the breakage of mainsprings.

Fig. 11 shows a perfect piece of steel, as discovered by the card-board and iron filings; the fiber or grain lies straight, and there are no hard spots or magnetic centers; there is only the natural, equal division of space by the dual force; the equator of force is in the center. This is the kind of steel sought for in the construction of watches, as its action is reliable when reduced to the delicate proportions necessary for hair springs, balance wheels and mainsprings. The illustrations represent chance pieces of steel, and represent the average conditions of the metal in general use. These hard spots, or crystalline spots, occur in all metal, but are still more detrimental in the non-magnetic metal where we have not the magnetic life or magnetic cohesion to assist in retaining the molecules in fibrous form, or condition. These illustrations of conditions are equally instructive when applied to material to be used for locomotive building.

To show the different, or varying, influence of this spike on the balance wheel according to their relative positions, we place the glass near the edge of the table; in order to allow the spike to be moved perpendicularly, Fig. 12, we hold the spike so that its lower end is about even with the surface of the water, A, B, and the balance wheel will vibrate to the position D. Then as we lower the spike so that its upper end is on a level with the water, B, B—the balance wheel vibrates to E, as shown by the dotted outline, and the balance wheel will be vibrated freely, by raising and lowering the spike. This will partly explain why the watch varies when on or off the train.

Having given a general outline of the influences in which the watches of engineers must exist, as these lines of force exist everywhere in more or less intense condition, it is obvious that so sensitive a piece of mechanism as the watch must be more or less affected.

But this universal force which exists in, and surrounds the metals of the watch—this magnetic influence—is not an unmitigated evil, but on the contrary is a decided advantage when under proper control—like most of nature's forces, utilized, they are of immense benefit, while their attempted annihilation is equally detrimental. This control and utilization of the magnetic forces is accomplished by the use of a shield of highly magnetic metal, which has been found to protect the watch fully from all undue magnetic influence, and at the same time, allowing the use of brass and steel in construction of the compensating escapement, with which alone the highest horological accuracy has been obtained, and this protection is attained by utilizing the

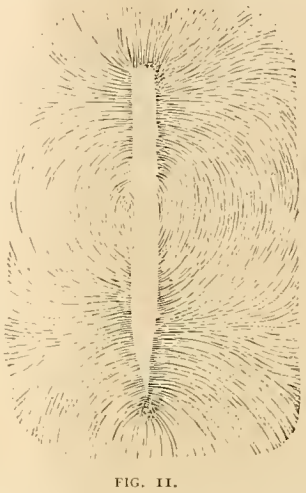


FIG. 11.

same natural law which causes the trouble, or using the same dual magnetic force to protect the watch,—and we secure this result by surrounding the watch movement with a circle of highly magnetic metal, which will secure the lines of force existing in any charged atmosphere, and hold them in a complete circle or closed magnetic cir-

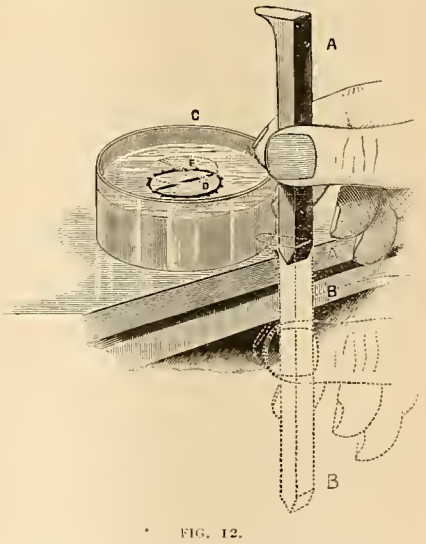


FIG. 12.

cuit, where all the inclosed space will be neutral, or in a state of satisfied polarity.

The Electric Light in Melbourne.

Charles Flesch of Melbourne, Australia, who has been making an extended tour of Europe and America, investigating electric light and electric power systems, passed through Chicago last week on his way homeward, and gave the WESTERN ELECTRICIAN a call.

Mr. Flesch is installing in Melbourne an alternating plant of 100,000 lights of the Zipernowski-Deri system, patents for which he controls in Australia. At the coming fall exhibition he expects to have a plant of 1,000 arc lights in operation, 650 of which will be of the Brush system.

The gentleman pays the Westinghouse meter a high compliment. He regards it the best made either in Europe or America, and in proof of his confidence has given the Westinghouse company an initial order for 500 meters.

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CONTENTS OF THIS NUMBER.

Plant of the Electric Light and Gas Company of Woodland, Cal., Illustrated 91, 92
Old Time Telegraphers 91, 92
Electrical Matrix-Making Machine, Illustrated 92, 93
Magnetism in Watches, by C. K. Giles, Illustrated 93, 94, 95
Electric Light in Melbourne 95
Editorial 96
Dayton Electric Railway 97
Chicago Telephone Controversy 97
Girl Telegraphers in Texas 97, 98
Machine Telegraphy 98
Alternating vs. Direct Current Distribution, Communication by H. Franklin Watts 98
New York Board of Electrical Control, Rules and Regulations 98, 99
Wires in Washington 99

DEPARTMENTS.

Correspondence 99, 100
The Electric Light 100
The Electric Motor 101
The Telegraph 101
The Telephone 101
Electrical Patents 102

THE rules and regulations of the New York Board of Electrical Control, as now in force, are spread before readers of the WESTERN ELECTRICIAN this week. They possess a general interest in view of the agitation now in progress in that city in electric light circles.

MR. GILES, who has made a careful and exhaustive study of the effects of magnetism on watches, presents in this issue some novel ideas as the results of his prolonged investigations. The prevalence of magnetic lines of force seems to be well attested by the proofs he brings forward.

THE proposed ordinance reducing telephone charges is soon to come before the Chicago city council. It is to be hoped that the aldermen will thoroughly examine into the subject before taking action. No one wishes to see an acrimonious telephone fight in Chicago which will work the greatest inconvenience to the public.

DAVENPORT, IA., and Dayton, O., have been added within a fortnight to the places operating electric railways. The success of the system at the latter place is well told in a very few words, preserved as they appeared in the brief communication to the WESTERN ELECTRICIAN. The road at the former place starts off under brilliant auspices as well. Success to both!

THE Chicago meeting of the United States Military Telegraph corps and the Old Time Telegraphers' association was thoroughly enjoyed by all those who were fortunate enough to be in attendance. The telegraph corps decided to continue its struggle to obtain recognition from Congress for the services which were performed during the rebellion. It seems surprising in view of the responsibilities which the operators assumed, and the faithful manner in which their duties were performed, that Congress has for so long a time denied them the small favor for which they ask. The want of congressional recognition, however, did not mar the pleasure of the reunion. No body of men enjoy annual meetings more than the telegraphers of the old days. For two days they lived over the thrilling experiences of their military life and they re-cemented the friendships formed a quarter of a century or more ago.

IN another column it is noted that the officials in the court house in Rochester, N. Y., complain bitterly because gas is to be substituted for electricity for illuminating the building. It is no wonder. The air, they say, has been purer and the employes have not suffered from headaches and dizziness since electricity was introduced in the building. The change is made on the score of economy, but is it wise economy?

A UNITED STATES senator is quoted as saying in Congress that he did not believe there was a successful electric road in the country. Where can the senator have been in the last few months? What has he been reading? In that period electric roads have met with the most signal success. Electrical engineering has prevailed against every kind of obstacles and discouragements, and it is almost universally admitted that the electric road has thus far presented the best solution of the rapid transit problem which is proving so vexatious in many cities.

THE Telephone association will hold its convention in the assembly room of the Hotel Brunswick, New York city, September 4th and 5th. The hotel is situated on Fifth avenue, just above Madison Square, and only two blocks from the new club house of the Electric club, the privileges of which have been tendered to the members of the associaton during the meeting. The association will probably occupy two days with its business, and the third in visiting points of interest in New York and vicinity, under the guidance of some of the local members. It is desirable that all attending the meeting, should make their arrangements so as not to leave the city earlier than the morning of Friday, September 7th. The coming meeting—the first ever held in New York—is expected to be one of unusual interest, both from the character of the papers to be presented, and the anticipated large attendance. It is hoped and expected by the committee that for the first time in several years, every company composing the active membership will be represented, and that a very large proportion of the associate and honorary members will be on hand.

THE semi-annual convention of the National Electric Light association will be held next Wednesday, Thursday and Friday, August 29th, 30th and 31st, respectively, at the Hotel Brunswick, New York.

The value of these meetings is so thoroughly recognized that it is needless to urge members of the association, or those interested in the application of electricity to lighting or the transmission of power, to be present. The number in attendance is increased at each succeeding convention, and the interest in the proceedings keeps pace with the increased attendance.

As announced last week no reduced rate of railroad fare could be secured from the Trunk line association, but Chicago members of the association have succeeded in obtaining a most satisfactory round trip rate which will be good from August 27th to September 17th, or a period of about three weeks. Those who wish to go will be informed of this rate upon application to the WESTERN ELECTRICIAN.

The programme for the trip is as follows: Leave by the Niagara Falls line from Dearborn station on Polk street, at 9 P. M., August 27th, arriving in New York at 7 o'clock, the second morning, Wednesday, August 29th, the first day of the convention.

Those who desire to stop off at Niagara Falls can leave from the same station at 3 o'clock in the afternoon, arriving at the Falls at 8 o'clock the next morning; from 8 o'clock to 3 o'clock the afternoon of the same day, can be spent in sightseeing; the trip will be resumed at 3 o'clock and the traveler will reach New York at 7 o'clock the next morning.

It is proposed to charter a sleeping car from Chicago for the exclusive use of those leaving from this city, and there is every probability that the car will be filled. The sleeping car fare to New York in this event will be less than four dollars.

MR. WATTS pays Mr. Tesla's paper on alternating current motors a deserved compliment, and rightly characterizes the era in the history of electrical engineering that we have entered upon, an important one. The idea he brings out that the successful transmission of the great water power of Niagara Falls the length of the Empire state to New York city or other great centers of population through the medium of the alternating system has the merit of novelty, to us at least. All in all, he pictures a brilliant future for the alternating current.

But who shall limit at this day the field that either the alternating or direct current shall occupy, to the exclusion of the other? In the prolonged discussion of the comparative value of the direct current and the alternating current before the Chicago Electric club, advocates of the former system gave a place to the latter in territory of wide extent and sparsely settled, claiming that their system possessed superior advantages for lighting in densely settled places readily reached from a central station. Mr. Watts regards the outlook as promising to do away with direct current distribution from central stations—a conclusion the friends of the direct current will hardly be prepared to accept.

IF the statements of a New York paper are to be believed many electricians in the metropolis entertain grave doubts as to the expediency of executing criminals by electricity in the near future. It is asserted that the experiments upon animals have decreased the faith of experts in electricity as an executioner. No doubt is expressed as to the power of currents to effect death, but it is insisted that it will be difficult to determine the resistance of the body and as a consequence it will be almost impossible to calculate the required strength of the current. If a mistake were made, it has been urged, mutilation might follow, and the spectacle be of a horrible character.

On this subject Ralph W. Pope is quoted as saying: "Some men are much more susceptible to the influences of electricity than others, and there are not sufficient reliable data to base calculations upon. There is no doubt of the ability of electricity to kill, but it may overdo it, and be accompanied by some horrifying consequences. Then there is some question as to whether a man apparently dead from an electric shock may not be brought back to life again by applying proper and prompt treatment."

Four months will elapse before the new law goes into effect, and certainly in that time the problems which have been suggested can be solved. Although the new law has been discussed to some extent, still the attention of electricians has been particularly addressed to it only within a comparatively short time. In this connection a statement of F. W. Jones, of the United Lines Telegraph company in New York, is worthy of notice. He says: "If the state would select a really competent electrician, capable of collecting and utilizing all known facts and experiments, and then provide him with proper apparatus, there is no doubt that he could produce death, and I do not believe the subject could be revived; but even then they might not escape mutilation. My idea of the best way to execute criminals by electricity would be to place a belt around the body below the arms and attach the two electrodes to plates, one on each side of the body, thus reaching the heart by the most direct route. This I consider preferable to sending a current through the brain, as advised by some of the scientists. I am afraid, however, it may prove somewhat barbarous at the outset. It is a matter that should be more definitely determined before attempting to kill even criminals with it."

In view of all these facts it seems curious that no official investigation is in progress to determine the best methods to be employed. The legislature, when it decided upon the change, did a wise act, but the matter should not be dropped until occasion necessitates the immediate employment of a method for the execution of a criminal.

The Dayton Electric Railway.

The first trip over the completed White Line tracks at Dayton, O., was recently made at midnight. Major Brookfield, John Kilgour, Captain Stone of the Central Union Telephone company, Wm. Smith and Albert E. Clark of Cincinnati, Hon. John A. McMahon and Dr. J. E. Lowes of Dayton, and E. P. Morris of Chicago, representing the Van Depoele electric railroad system, composed the party of inspection.

At 11:30 P. M. E. P. Morris connected the motor car with the overhead wire, and the car started on the first trip over the road. When the cars passed the Phillips House a number of persons boarded them to take a free ride to Riverdale. The cars passed down Main street smoothly at a rapid rate, and when Riverdale was reached Mr. Morris began ringing his gong lustily. The residents were awakened and were soon out. There was great excitement and cheering. The cars made eight miles an hour most of the trial trip, but for short stretches ran at a ten-mile rate, and are capable of making 12 miles an hour. Mr. Morris, writing the WESTERN ELECTRICIAN, under date of August 12th says: "I am running ten cars now and everything tip-top, with all new men who never saw an electric car before."

Chicago Telephone Controversy.

The ordinance of the Chicago city council which directed the commissioner of public works to issue no more permits for the extension of the telephone system, has created no end of bitterness in the city. It is said that the company has been obliged to refuse 200 applications for instruments on account of the action of the council. Business men whose rivals possess telephones complain bitterly, and assert that they are handicapped. Although the council in passing the ordinance aimed a blow at the company, it is said that the citizens feel its effects far more severely. Superintendent Wilson recently said that the company could supply all applicants if it were not for the prohibitory order. "We have made plans to give Chicago the most perfect telephone service in the world by a consolidation of our offices," he said, "but we can now do practically nothing more until we can extend our underground system, which the order of the council prevents. We are putting in some telephones on private property, but that is all."

When asked his opinion on this subject recently, City Electrician Barrett said he had a poor opinion of the ordinance. "I have," said he, "as high as fifty persons a day here making complaints and inquiries about the difficulties which they are laboring under. They cannot see the sense in the order of the council; neither can I. It should be abolished at once."

The proposed ordinance reducing the charge of the telephone company to $75 will soon come before the council for action. It is asserted that the validity of the company's franchise may be called in question. If it should be declared invalid the Cushman franchise would suddenly become valuable. It should be stated that the officers of the Chicago company are not worrying about the matter. In fact they think their position is strong enough for all purposes. President Phillips recently said on this subject in reply to a question, "We would never accept their ordinance, which limits the charges for telephones to $85 and $90. There is one thing rather peculiar. In other places where I have had to do with corporate authorities, and measures affecting us have come up in the city councils for passage, committees have been appointed and I have been sent for in order that an interchange of views might be had. But I have not been so invited before any committee of the Chicago city council, and so I take it for granted that they have no business with me. Aside from this circumstance I have no reason to doubt the sincerity of the promoters of the Cushman ordinance. Indeed, I have every reason to believe that within a few days of Judge Blodgett's decision, they intended to go ahead with their enterprise. To be sure, so far as I have learned, none of the men connected with the company have any means to speak of, but if their franchise is valuable they could, of course, soon overcome that."

"It will be valuable if the city beats you in a suit to cancel your franchise, will it not? And it will be still more valuable if the American Telephone company beats the American Bell Telephone company on a rehearing or on a writ of error from Judge Blodgett to the United States Supreme court?" was asked by an interviewer representing a Chicago daily paper.

"Yes, it might be, under those circumstances, but both are improbable. We shall take good care to see that our franchise is not disturbed, and if the public can stand the prohibitory order of the council, certainly we can, for the present, at least. We are very anxious to come to a settlement with the council, so that we may proceed with the extension of our system, and therefore we dislike to create any bitterness in the controversy."

The Cushman company according to Assistant Corporation Counsel Knight, its legal adviser, has no intention of disposing of its franchise. He said his company was already in the telephone business and meant to go ahead and establish exchanges in Chicago under its charter just as soon as legal matters were settled so that they could obtain telephones. It was by no means the intention to form a company on paper for the purpose of securing a franchise which might be disposed of. "We got an ordinance in April last," said Mr. Knight, "but did not at once proceed to place wires and telephones in buildings because the case in the United States court between the American Cushman Telephone company, from which we obtained our telephones, and the Bell Telephone company had been set for June, and as our existence depended upon the result of this litigation we prudently waited the issue, which, as is well known, turned out against the Cushman people. This is why we have not gone ahead in Chicago. The Cushman people will endeavor to obtain a rehearing before Judge Blodgett, and if this is granted and they submit additional evidence, the present decision may be reversed, so that we can get instruments and go ahead. In that event we shall certainly do so. We have two years from the date of our ordinance—April 5, 1888—in which to open an exchange, so there is not much danger of our forfeiting our chartered rights."

Girl Telegraphers in Texas.

Some days ago a reporter had occasion to use a telegraph line in sending a report to the paper. It was long after midnight, and the nearest Western Union wire was a good mile and a half from the town in which he was located. The telegraph office was found to be in a railroad block station, situated in one of the loneliest and bleakest parts of the country through which the road passed. No dwelling houses were within calling distance, and the entire surroundings were of the most uninviting and forbidding kind. The office itself was but a small frame building, utterly devoid of any means of defence from intruders, and the country round about was infested with tramps.

The reporter knocked at the door, and receiving no answer, knocked again, with the same result. Finally, after a third summons, a window was opened, and a feminine voice timidly inquired, "Who's there?"

The surprise of the newspaper man can be better imagined than described. The idea of a woman being in charge of an office in such a dismal place seemed almost preposterous. He, however, explained his mission, and after a little delay was admitted by a delicate girl, who appeared to be hardly older than 18.

The little room was as neat and clean as a new pin. The floor was as white as a scrubbing brush could make it. On the walls were tastefully pinned a number of pretty advertising cards. A glass on a table near by contained a bunch of flowers, and a comfortable, home-like air pervaded the whole room, so entirely different from the average country railroad station with its foul odors of bad tobacco and oil. When the last word of the message was out the reporter questioned the young lady upon her work.

"Yes," she said, "this company has lady operators at night in all their offices as far east as the mountains. My office is not as lonely as some of the places up in the mountains, where the girls do not have an opportunity to talk to anybody from the time they leave the train at 6 o'clock in the evening until they return the next morning. It is an awful place even here, sometimes. Not a train will pass for hours at a time in the morning, and we must walk the floor to keep awake. At first I thought I would never be able to stand it, but it is growing easier now. At the beginning I was afraid of every sound. We form odd friends at such times. The best I have are the mice, who come out of their holes and eat the crumbs I leave on the floor for them. They are good company when there is nothing better."

"I should think that the company would give the lady operators day offices," we said.

"Well, it does not. They give the easy positions to the men. The only reason I can give for that, since you ask for it, is that young ladies are more careful, and do not go to sleep like the lazy men do, and pile up a wreck in front of the office."

"Are you not afraid of tramps?"

"Good gracious! yes. They are the bane of our existence. We are prepared for them, though!" said she, at the same time glancing at a loaded revolver, which had until then lain unnoticed within reach of her hand. "I had to use it once or twice. I did not want to shoot the man, and only fired to scare him."

"Have you had any odd experience while at this office?"

"There was one," she answered, "I will never forget. It was one of the coldest nights of last winter. Rain had fallen the night before, and toward evening, it had grown colder. After midnight the thermometer was down below zero, and a high wind was raging. About 2 o'clock in the morning somebody rapped at the door. I did not notice it at first, as I knew it was only a tramp. One had been loitering around all day and had insulted me the night before, and I thought it was the same one come back again. He kicked the door again, and I raised a window and asked him what he wanted. He said he wanted to come in, and if he did not get in he would break in the door. Then he began to swear at me. I told him to go away, and that I would not admit him. That made him more angry.

"He beat and kicked the door until I thought he would break it down. Then he tried all the windows, and finally came back to the door again. No train had passed for an hour before. None had left the city, and the nearest telegraph office was two miles away. I pulled out the drawer to get my revolver. It was gone! Then I remembered having left it at home that night to have it repaired. The man was knocking away at the door, and every moment I thought would be my last. I knelt down and prayed for assistance. The man at the door had grown quieter, and commenced to beg me to let him in. 'Great God! lady,' he said to me, 'I am freezing, and if you don't let me in you will find me dead here in the morning.'

"I opened the window again and begged him to leave, but he only continued to plead for admittance. His voice had grown weaker, and sounded so pitiful that I finally went down stairs to the door. I wanted to let him in, and yet I was afraid.

"At last I unlocked the door and turned the knob. The door of itself flew back on its hinges, and there fell in upon me one of the dirtiest, meanest, and worst looking tramps that I had ever seen. His clothes were covered with mud, and his face looked terribly fierce. I screamed, and turned to run away to escape him, when he caught hold of both of my hands and fell on his knees before me, and then and there poured forth one of the most beautiful prayers I have ever heard. It was so pathetic and full of thankfulness at times.

"Tears were streaming down his cheeks, and he kissed my hands repeatedly, saying I had saved his life. I repented and told him to come up stairs to the stove, but half way up the stairs he knelt and prayed again. He lay down by the fire for awhile, and after he had become warmed, he told me the story of his life—how he had become a drunkard and deserted his home. He said he had not eaten anything for two days, so I gave him my lunch. I kept him here for a couple of hours and then sent him

west on a freight. Every time I think of that man and that night I feel better, although everybody said I was foolish to let him in when I told the story at home."—*Galveston News.*

Machine Telegraphy.

D. H. Craig, formerly manager of the Associated Press, says an Eastern journal, has devoted nineteen years to the development of machine telegraphy, and claims to be able to telegraph 2,000 words per minute from each end of a wire, total 4,000 words in sixty seconds.

The messages or reports are legibly and uniformly recorded in ordinary telegraph characters, which can be read by clerks familiar with them at the rate of about 100 words per minute.

Messages, to be sent over the Morse lines, must first be written or printed; but a message to be telegraphed by the new system must first be perforated, for which Mr. Craig has a beautiful little machine, 8x10 inches, with two banks of keys, called a "composer," which even a child can operate reliably and quite expertly after an hour's practice, and after a reasonable amount of practice fifteen to twenty words per minute can be perforated. Simultaneously with the perforations, the machine prints, in plain Roman letters, every word of the messege, which is retained, while the perforated message is sent to the telegraph office the same as a message is sent in manuscript, to be telegraphed over a Morse line, with this difference—the machine message will be transmitted to destination at the rate of one or two thousand words per minute, and be legibly and accurately recorded in telegraph characters, and the Morse message will be telegraphed by the hand-key system at the rate of fifteen to twenty-five words per minute and be recorded by "sound" reading in ordinary manuscript. It is claimed that the machine record is three times more accurate than "sound" recording.

With the regular office perforator experts do reliably, fifty words per minute, or 3,000 per hour, and it is claimed by Mr. Craig that the actual cost of transmitting 1,000 words 1,000 miles is not over two cents.

The cost of paper to perforate 1,000 words is 1 cent, and 2 cents for recording paper. Experts, young men or young ladies, do perforating for 10 cents per 1,000 words, and the same for copying on the type-writer—total 25 cents for completing 1,000 words! On this basis it would cost for labor and paper less than $30 to telegraph and complete forty-eight columns of this newspaper from New York to Chicago.

"Mr. Craig has also devised a new telegraph wire, made of pure copper with a slight mixture of silica, which is said to increase the tensile strength to twice the strength of steel of equal size, the exact tensile strength being reported as 133,000 pounds to the square inch.

No. 4 gauge wire weighs over 900 pounds per mile, and has but one ohm of electrical resistance per mile. With such a wire, extending from New York to San Francisco, the electrical resistance would be about 3,000 ohms, while a majority of the telegraph wires between New York and Washington show an electrical resistance of more than 4,000 ohms—thus the new siliconized copper wire will bring San Francisco nearer to New York, electrically, than New York is to Washington.

Mr. Craig's apparatus is now on exhibition at Washington, in a room in the Capitol near the senate chamber."

The Standard Carbon company of Cleveland has brought suit against W. H. Boulton for an injunction restraining the latter from interfering with the plaintiffs' plant in Cleveland. On July 9, 1887, the Boulton Carbon company, the Cleveland Carbon company and the Crystal Carbon company entered into an agreement whereby they formed the Standard Carbon company, with a capital stock of $500,000. During the first year of the company's existence W. H. Boulton was its general manager on a salary of $3,000 a year. At the annual meeting the office of general manager was dispensed with. The defendant owns nearly half the stock of the Standard company. In consideration for his stock he contributed, at the time of the formation of the company, a lease of the premises on which the factory is situated. No formal assignment was made. After the action of the directors Mr. Boulton served notice on the company directing them to remove the property forthwith as he was entitled to exclusive possession. A temporary injunction was issued and the business will proceed until the decision of the court.

Alternating vs. Direct Current Distribution.

Editor WESTERN ELECTRICIAN:

SANDUSKY, O., August 14.—The paper read by Nikola Tesla, before the American Institute of the Electrical Engineers, May 16th and reproduced in the WESTERN ELECTRICIAN, is a most extraordinary one, and stands second only to that read by Professor Elihu Thomson upon "Novel phenomena of alternating currents." The latter was, without doubt, the most remarkable paper ever read before that body. Here was set forth a new principle—"electro inductive repulsion."

The development of the alternate current motor as described by Mr. Tesla, effectually forges the link that has hitherto been missing in the chain of application of the alternating system. Not only this; it is a prime motor, which, without brushes and commutator, and with an efficiency at least equal to direct current motors, gives a constancy of speed never before attained. The alternate current meter has also been perfected, and constitutes a necessary component of a complete system.

We are about to enter, or have already entered, an important era in the history of electrical engineering, and can foresee improvements as great and radical as those which characterized the invention of the Corliss engine in the department of steam engineering.

An ideal system of electrical distribution is one that permits the use at will of arc and incandescent lights, and motors upon the same circuit with safety and economy, and is at the same time capable of very extended distribution. The alternating system accomplishes all this. What more, then, do we want? With such men in the field as Professor Elihu Thomson, O. B. Shallenberger, M. M. M. Slattery and others, what less can we expect? The field of alternate current apparatus is rich in original research, and will amply reward the diligent worker.

In the discussion of this subject before the Chicago Electric club, the alternating two-wire has been invariably compared with the direct three-wire system. It is to be remarked that the three-wire system is applicable to the alternating, and a saving of 62½ per cent. in cost of copper can be effected here as well; indeed, an alternating three-wire system would possess certain advantages over the direct system, even of the same potential. The cumbersome compensator can be done away with entirely, and regulation effected by apparatus which has no moving parts, and which "is the simplest piece of mechanism imaginable"—a single coil of correct proportion, wound on an iron core. The two ends of the coil are connected to the two outer wires of the three-wire system, while the center of the coil is attached to the middle wire. The side of the coil having the highest potential will then become the primary, and the secondary will deliver its current to the heavily loaded side, or the one having the lowest potential. This apparatus can give good regulation, moreover wastes no power, and requires no attention. The fact that we can replace a lamp or other device upon an alternating circuit by a "reaction coil" and do so with economy of power, is alone a great point in favor of the alternating system.

We can double or reduce our potential in any desired ratio, and for any special requirement. We can cause our current to have the characteristics of a flash of lightning, or we can render it so harmless that it can be safely handled by a child.

The problem of the successful electrical transmission of the power of Niagara Falls to New York and other cities will be solved by the alternating system, if solved at all. Here the mighty question that has puzzled the wisest heads, what can we do with the enormous potential which must necessarily exist at the New York end of the wires, is easily disposed of in the transformer.

It has become known, and the first mention of the fact, I believe, is to be credited to Dr. Otto A. Moses, that if the same proportion of parts exists in large alternate current machines as in small ones, both will be equally successful. What, then, is to prevent the construction on large machines? What we want in our central stations are alternate current machines of large size and capacity, having armatures four and six feet in diameter, driven directly by engines upon the armature shaft; these machines to have a capacity of 5,000 to 100,000 sixteen candle-power lights. Electric lighting will then be carried out on a grand scale. Our stations will be smaller for a given output, cleaner, better arranged, and less liable to accident. Compound condensing engines can be used, and the highest steam economy attained. Stations can be located on inexpensive grounds with regard to coal and water supply. Higher potentials can be used, although 1,000 volts is probably the most desirable. The dynamos will be improved, and have an efficiency comparable with direct current machines. Motors will be operated upon the alternating circuit without commutator or brushes, arc lamps will be run in parallel and alongside the incandescent. The alternating arc lamp will quiet down and become more of a favorite. Alternate current machines will be coupled in parallel with little or no difficulty. If the alternations do not at once coincide, some operation as simple as opening the cylinder cocks of the engine will change the speed sufficiently to bring them into step. This, once established, is capable of considerable strain without danger. All this accomplished, one of the greatest engineering problems of the age, the transmission of electric energy over great distances to fulfill commercial requirements with safety and economy, will have been effectually solved.

It is not unreasonable to suppose that the "exciter" used in the alternating system can be dispensed with, and the principle of "mutual accumulation" can be applied to these machines, and their fields excited by their own current in connection with "reaction" or "choking coils" or something of that sort. The commutator will then be absent entirely throughout the system, and much trouble and annoyance avoided. Alternating will prevail against direct current distribution from central stations, while the direct current system will continue in popularity for local and isolated lighting.

H. FRANKLIN WATTS.

New York Board of Electrical Control.

RULES AND REGULATIONS.

Electrical conductors are divided into two classes: 1. Those for telegraph, telephone, and similar service. 2. Those for electric light and power, and similar service.

II. No two lines of poles bearing conductors of like class shall be erected on any street or avenue.

III. No two lines of poles shall be erected on the same side of any street or avenue.

IV. All conductors of the second class shall be screwed to insulating fastenings, and covered with an insulation which is waterproof on the outside and not easily worn by abrasion. Whenever the insulation becomes impaired it must be renewed immediately.

V. Poles shall be placed upon the sidewalk, as near the curb as possible, and no pole shall be placed within ten feet of any lamp post or other pole.

VI. All existing regulations of the local authorities in regard to the placing of poles and stringing of wires are to continue in force, and the rules and regulations of the New York Board of Fire Underwriters must be strictly observed.

VII. All wires shall be fastened upon poles or other fixtures with glass, porcelain or rubber insulators.

VIII. No wires of the second class shall be stretched within one foot of any pole without being attached to the same with glass, porcelain or rubber insulation.

IX. No wires of the second class shall be stretched within twelve feet of the ground or within two feet of any building, except when attached thereto with glass, rubber or porcelain insulators.

X. No electrical conductors shall be stretched over any part of any house or other building, or attached thereto, except by permission of the owner thereof, and all conducting wires of the second class must be at least seven feet above roofs, and placed so as to avoid ladders of the fire department and shutters.

XI. The companies or persons owning or controlling poles in any street or avenue shall allow the same to be used by other companies or persons operating conductors for similar electrical service when authorized so to do by the board, on tender of proper compensation, to be determined by agreement between the parties interested. In default of such an agreement the amount of such compensation shall be determined by the board. This rule imports a contract on the part of each company or person owning or controlling the poles in any street or avenue, not only with the board but also with each company or person who shall under its terms be qualified to demand the privileges it confers.

XII. All permits of the board for overhead wires and fixtures are granted only pending the providing of underground accommodations in the neighborhood of the street or avenue for which the permit is granted.

XIII. Any member or officer of the board, and every inspector employed by it, as well as every member of the police force of the city, shall be entitled to examine permits under which work of any kind is being done.

XIV. No permit shall be granted for the erection of any overhead structure nor for the renewing of any lines already existing in any street, avenue or highway in which underground accommodations for the service have been provided, or are being provided.

XV. All poles now standing, or to be hereafter erected, shall be branded or stamped with the initials of the company owning them, at a point not less than five nor more than seven feet from the street surface. When an odd pole is taken down it must be removed from the street the same day. New poles must not be brought upon any street more than two days in advance of their erection. Any pole that shall lie on any street more than two days shall be removed by the bureau of incumbrances of the department of public works, at the expense of the party owning it.

XVI. All companies or persons having poles in the public streets shall give a bond to the city in a reasonable amount, to be determined in each case by the board, conditioned for the payment of the cost of removing dangerous and abandoned poles, and also for the payment of the expense of restoring the sidewalks and pavements where the same have been disturbed or injured in consequence of the erection or removal of any pole owned by them.

XVII. The violation of any of the rules and regulations of the board, shall operate *ipso facto* by a revocation of the permit held by the company or person guilty of such violation.

XVIII. Whenever hereafter any company shall be permitted by this board, or its successors, to erect posts or poles, or other fixtures bearing lamps or other devices for the purpose of lighting by electricity, the streets, avenues, highways, parks or public places of the city, the said permission shall be granted only subject to the following provisions, and the same is hereby expressly made a condition of said permits: At any time when, by action of the city authorities, the contract for lighting any such street or other public place shall be given to another company, the company erecting said lighting fixtures or lamp-posts shall, on tender of the first cost thereof, yield possession and ownership of the same to the said other company obtaining the new contract.

XIX. Electric light lamp posts shall be in accordance with the plan adopted by the board.

XX. All broken and "dead" wires, and all wires, poles, and fixtures not actually in use, must be removed from the streets, avenues and highways of the city.

PERMITS.

XXI. The general permit, giving electrical companies the right to repair their lines of conductors where needed, is continued and made obligatory upon said companies. This general permit does not, however, cover the erection in any street, avenue or highway of any new poles or other similar fixtures, and has absolutely no reference whatever to lines which have been ordered underground by the board, and which the mayor has been requested to remove. In the case of such lines, where notice has been given that underground accommodations have been provided, and the

ninety days of notice required by law have elapsed, and the mayor has been requested to remove the same, companies owning or operating said lines are not authorized to make any repairs or connections or to go upon the poles bearing such lines *for any purpose whatever*, except to remove the said lines of electrical conductors in conformity with the directions of the board. Any deviation from this rule requires a resolution passed at a regular meeting of the board, attested by the secretary.

XXII. The secretary is authorized to issue to companies operating electrical conductors *of the first class*, all permits required by them for the making of connections necessary to the business of said companies with lines now in use, and which the mayor has not been requested to remove, not including the erection of any new poles or similar fixtures—said connections to be in every case in accordance with the rules and regulations of the board.

XXIII. No poles, lamp posts or other similar fixtures shall hereafter be erected in any street, avenue or highway, except upon resolution passed at a regular meeting of the board, attested by the secretary.

XXIV. No conductors of the second class shall hereafter be placed above or under any street, avenue or highway, except upon a resolution of the board, passed at a regular meeting, attested by the secretary.

XXV. No applications for permits for the erection of poles or the placing of wires of the second class, will in any case be considered by the board, when made by companies owning or operating electrical conductors in violation of these rules and regulations, or in defiance of any order of this board.

XXVI. These rules and regulations are subject to revision and alteration.

The following were added to the rules and regulations July 2, 1888:

DAY CIRCUITS.

All circuits which ever carry a current exceeding 500 volts, between 9 A. M. and 4 P. M., must be painted red for a length of two feet at each insulator.

NUMBER OF CIRCUIT.

Every electric wire carried on poles must be indicated by a number plainly marked on each cross arm under the insulator.

STATIONS.

All circuits must be tested every hour when in operation, and when a ground comes on, effort must be made to remove it at once; failing in this, the current must be discontinued until the insulation is restored.

CERTIFICATE OF INSPECTION.

From and after August 1, 1888, no company shall do business of arc electric lighting in the city of New York without a certificate of the board, granted on recommendation and after inspection by the expert of the board, to the effect that its lines comply with all the rules and regulations of the board, and that its plant is in proper condition for the doing of its business. The force of the certificate to continue until changes are made, of which the board must be notified and approve, or so long as the plant and conductors remain in the same condition as when inspected.

Wires In Washington.

Senator Edmunds, August 16th, introduced in the United States Senate a joint resolution to restrain the erection or maintenance of overhead electric power and electric light wires in Washington and Georgetown. It was referred. Mr. Edmunds' motion of the preceding day instructing the committee on the District of Columbia to report a resolution requiring the commissioners to revoke the permits already given for overhead electric motive wires, was taken up. Mr. Sherman condemned the proposition as one that would coerce the committee on the District of Columbia to report a resolution to suit Mr. Edmunds' views without any investigation. Mr. Edmunds declared himself just as much in favor of increasing and improving the modes of travel in Washington as anybody, and said he was as ready to vote money for it, although he didn't happen to own any suburban real estate. He was not one of the proprietors in Eckington, to which this road was run, nor did he own land just at the Soldiers' home by the line of this railroad. He wanted to see good electric railroads run to Eckington and to the Soldiers' home, and to the north and to the beautiful Arlington hills, but he did not want to see them put up in a way injurious to the public welfare or in a way that would destroy the beauty of streets and avenues and threaten with death everybody passing along. Mr. Vest spoke of the unquestionable superiority of the electric or of the cable system of street railways over the horse system. Mr. Teller did not believe there was a successfully operated electric road in the United States. So far as his information had gone not one of them was satisfactory. There was one in Denver to which as much ability, learning, zeal, and capital had been applied as to any in the United States, and it was a failure. Finally Mr. Edmunds' motion to refer with instructions was agreed to—yeas 22, nays 18.

A terrific thunderstorm passed over the Cape at 12:30 o'clock to-day, says a Cape May dispatch of August 18th. The residence of Mrs. Ohl, at Cape May Point, was struck by lightning and shattered. Two children were partially stunned by the shock. An electric light pole at the Grat street station was struck and the lamps shattered, and the platform men near by were severely shocked. A sheet of lightning passed over the roof of the Arlington hotel opposite, and it is said that it threw the skylight out of place. The rain fell in torrents.

CORRESPONDENCE

New York Notes.

NEW YORK, August 18.—It is rapidly becoming apparent that the overhead electric wires are by no means the only dangerous structures which menace the lives of our citizens. The truck drivers, the bobtail cars, and more recently burning factory buildings, have all been subjected to the criticism of the daily press, but no movement has been started by any kind of an "engineer" to prohibit their "damnable" work. It appears strange that electricity should have been singled out for a series of attacks, unreasonable and unjust in many instances, and it can only be accounted for on the supposition that some interest is working against them.

At the inquest recently held in the case of the Chrystie street fire, where many lives were lost, the superintendent of the bureau of inspection of buildings testified that the law was fully complied with in regard to fire escapes on the building, but he did not think the law was ample in providing for the proper construction of such buildings. Thousands of persons he stated were daily exposed to just such a fate as was met by the men and women at the Chrystie street fire. So far as choice of death is concerned, most persons would probably prefer that electricity be the instrument.

The electric and the photographic sections of the American Institute will have their annual field day excursion at Coney Island on August 21st. No definite place or time of starting has been announced, but all are expected to "get there" by the most available route. Headquarters will be established at Hotel Brighton, where O. G. Mason, chairman of the reception committee, will be in attendance all day. If the day is stormy the excursion will take place on the next fair day, as it is desirable to have a good light in order to give the amateur photographers a fair chance.

The Board of Electrical Control appears to be getting along very well with everybody excepting Mayor Hewitt and the United States Illuminating company, or such parties as seem to be under their influence. A letter has been addressed to the board of aldermen by Secretary Moss in which the co-operation of that body is invited with a view to the enforcement of proper regulations, such as those already promulgated by the commissioners. It is believed that if these rules can be rigidly enforced the electrical service in the city can be made safe, uniform and effective, and the risk to life and property reduced to a minimum. The attention of the aldermen is directed to the numerous "dead" poles and wires, and also to those in use which have never received the proper sanction of the authorities and which are "maintained and contained" without permission of the Board of Electrical Control, and in violation of the laws of the state. The fact is made plain that 122 complaints have been sent to the department of public works, and nothing has been done by the department to remove the obstructions. It is pointed out that the United States Illuminating company has never been duly authorized to stretch any wires above ground, and that 528 violations have been reported against that corporation.

Corporation counsel Beekman has caused to be served upon the United States Illuminating company the summons and complaint to the suit which the city has brought against it in the Supreme court, asking that it be compelled to remove its wires from the streets, and place them underground in accordance with the orders of the board which the company has disobeyed. The city also asks for $5,000 damages.

The bill which has recently passed the senate for the regulation of telegraphic communication, does not appear to have attracted much attention, but its provisions are of great importance and if strictly enforced will lead to some radical changes in existing methods of handling business. For instance it is declared unlawful for any telegraph company to give any unreasonable preference or advantage to any particular person, company, firm, corporation, locality or class of business in any respect whatever, or to subject the same to any unreasonable discrimination or disadvantage in any respect whatever, etc. It is well known in telegraphic circles that unusual facilities are given to brokers and speculators; that special wires are given to them, and that the service is almost instantaneous under ordinary circumstances, while in case of accident to the lines the ordinary business is subjected to delay in order that brokers' messages may be promptly handled. This has been the practice for years although the law requires (probably in every state in the Union) that messages shall be transmitted in the order of their reception.

Coroner Nugent held an inquest August 15th in the case of William Muir who was killed by coming in contact with an electric light wire in the Adams Express company's building July 16th. Charles M. Kenna an engineer in the employ of the company, testified that the deceased was employed as a cleaner and trimmer of electric lamps. On the day in question he went into the room where Muir was working and found him dead on the floor under a lamp which was trimmed and burning. The jury rendered a verdict accordingly, and recommended that in future the express company employ more intelligent men for such work.

It is now generally believed in this city that Robert Garrett is hopelessly insane, and that his long trip has been of no permanent benefit to him. His friends believe that it will be best to place him under restraint on account of his extreme violence at times. The fact that he considers himself a victim of Jay Gould indicates that his troubles have been brought on by the strain of railroad and telegraph competition. P.

From Kansas City, Mo.

KANSAS CITY, Mo., August 18.—The electrical business is picking up. The Kansas farmer has managed to gather in a most respectable crop of wheat and the prospects for garnering a corn crop of most formidable proportions are also favorable. This has created a better feeling throughout that state and the adjoining regions, enterprises are moving along more rapidly, and the electrical manis feeling its effects along with other lines of business. The dealers in supplies report an increased demand, and the agents for electric light and power companies report the receipt of more inquiries than they can attend to. These inquiries are more numerous concerning the transmission of electric energy in the way of motors in mills and factories and motors for street railways. The latter are very popular, and it is a very small and lifeless town in the west that is not now agitating the establishment of an electric street railway.

Two railways are being projected in this immediate vicinity. One is in Kansas City, Kan., just across the river, and the other is at Excelsior Springs, a Missouri summer resort, controlled by Kansas City, Mo., business men. The Kansas City, Kan., railway is projected by a company incorporated under the name, West Side Railway company. It is to run throughout the town on Minnesota avenue, one of the main streets. Branches will be constructed to the different parts of the city and it is expected that the total length of the road will be fifteen miles. The capital stock is $500,000. The directors are, L. H. Wood, C. F. Hutchings, J. D. Husted, W. L. Wood, E. J. Camp, T. H. Rowland, and O. R. Burnham. James D. Husted is president, W. L. Wood secretary, and L. H. Wood treasurer. The company proposes to construct a line similar to those in operation in Richmond, Va., Scranton and Allegheny City, Pa. An ordinance granting the company a franchise has passed the council of Kansas City, Kan. It provides that the wires shall be placed underground whenever any practicable scheme for so doing shall be invented; that the road shall be completed within eighteen months; that flagmen shall be stationed at all crossings where it shall be deemed necessary; that cars shall run from 5:30 A. M. to 12 o'clock midnight, at intervals of not less than 10 minutes; that a tax of $12.50 shall be levied on each car every six months, and that the company shall give a bond for $5,000 for compliance with the provisions of the ordinance.

Howard M. Holden has returned from a trip to the northwestern States. During his absence he investigated the merits of the Van Depoele system of operating street cars by electric motors, the patents for which are now owned by the Thomson-Houston Electric company, and, as far as his investigation extended, is well satisfied with that system. In the town of Appleton, Wis., a place of some 12,000 inhabitants, the street cars have been operated by the Van Depoele system for a little over two years. "The people of that town seem to be well pleased with the system," said Mr. Holden. "It has stood the test for more than two years now, and, so far as I was able to discover, the people have never yet complained. The cars run very smoothly and with comparatively little noise. My investigations were made with a view to building a road from the Chicago, Milwaukee & St. Paul depot at Excelsior Springs to the Elms hotel, a distance of about a mile. The company is seriously contemplating this step, and before long will probably make the connection. I am very favorably impressed with what I saw at Appleton, Wis., and it is among the probabilities that the road will be built."

The Metropolitan Street Railway company of this city is closely watching the operation of the electric roads of the country. If they should prove successful during the winter, the company propose to build in Armourdale or on the southwest boulevard to Rosedale, and perhaps both. A. J. McCarty, of the company, and C. J. Hubbard, representing Boston capitalists, visited St. Joseph and investigated the operation of the electric roads there. In his official report to his company, Mr McCarty said: "I found two miles and three-quarters of road containing seven right

angular curves and a four per cent. grade in operation. Six cars were running at a rate of speed equal to that of an ordinary horse car's, although greater speed could be obtained if desired, for at my request a car was run at the rate of fifteen miles an hour, and from what I saw on that day the road seemed to be in successful operation. The Sprague system of overhead power is used, although it may be changed to a conduit system if desired."

Robert Gillham, the well known engineer of this city, who has been the constructing engineer of most of the cable lines in this city, and is now the constructing engineer of the cable line of the Denver Street Railway company, proposes to make a test of the electric railways now in operation. He will be accompanied by Captain G. S. Griffith of the United States army.

Kansas City was suddenly enveloped in darkness one night recently. The wires became entangled at the Union depot in the bottoms, cutting off the upper end of the circuit. About the same time the electric light wires set fire to the signboard of a Main street saloon, making it necessary to cut the wires, which left Kansas City depending on gas, candles and kerosene.

A bill of complaint was filed in the office of the United States circuit court, July 25th, by the American Bell Telephone company against the Johnson County, Mo., Telephone company and others, asking that an injunction be issued on the ground of infringement of the right granted the Bell company by letters patent. Notice was received last week that the papers had been served. The Johnson County company was operating the Pan Electric telephone in Warrensburg and Holden. While the company expects nothing else than to be closed up, it does not expect to be compelled to pay any damages, for it has been charging only one-fourth to one-half the usual rates of the Bell company, and the Bell company has declared that for it to charge only the rates of the Johnson County company would be for it to lose money. The company will ask the court wherein the Bell company has been damaged when it would have been a loser had it been operating the exchanges.

A number of telephones have been rendered useless in this city recently by the storms, causing telephone wire to come into contact with electric light wire.

The Kansas City Electric Light company has been sued for $10,000 damages by John W. Higgins for personal injuries received by coming in contact with an electric light wire at J. A. Frame & Co.'s turf and field rooms. He lost one of his fingers, and says his health has been permanently impaired.

The Thomson-Houston company has been granted the contract by the Kansas City Exposition company for a $20,000 electric light plant at the exposition building. The plant is to be in operation by September 10th. A.

From St. Louis, Mo.

St. Louis, August 18.—The St. Louis Street Railway company proposes to adopt the electric system for motive power on its line, plans for the proposed change having been submitted to and approved by the Board of Public Improvements. An experimental plant will be put in soon, the permit for its construction covering a period of only nine months. The plan is to establish a central station whence power will be supplied the cars by means of overhead wires. The territory covered will extend from Wyoming to Keokuk street on Broadway, the tracks now used being retained. The cars will be supplied with two motors, one being a reversing motor to facilitate stoppage. The conducting wires will be placed at a height of 18 feet above the street, and will be so insulated as to be absolutely harmless, even should they become grounded. The wires will be supported by cables stretched across the street at intervals of 125 to 150 feet, which will be suspended from ornamental iron uprights, of wrought iron. The cars will be illuminated by electric lights, and the forward car will be supplied with an electric head light. There is at present an ordinance regulating the elevation of overhead wires at 25 feet, but it has been set aside temporarily. President Flash of the Board of Improvements will, if the line proves a success and the electric motor is adopted by the company for its entire system, advocate placing the conducting wires 80 feet overhead. C.

St. Louis, Mo., August 18.—Telephone linemen in this city are using a novel ground detector. The instrument consists of a wooden box, containing a shuttle twelve inches long, wound longitudinally, with about 1,000 turns of number 32 wire, the ends of which are connected with a telephone. In testing a telephone circuit magneto bells are first used. If a ground is discovered a battery of five cells is connected, one pole to one side of the grounded circuit through a vibrator and the other pole to earth, the idea being to send an interrupted current through the circuit to the ground at the place where the fault exists. The lineman then takes his detector, climbs a pole, connects the instrument to the line that is grounded, and in case he hears the vibrator, he knows he is on the battery side, but in case he does not hear the interrupter, he knows he is beyond the ground. By testing the line at different places he is soon able to locate the ground. One lineman claimed to be able to remove more grounds in a day by using this instrument than three men could in the old way.

Articles have been filed for the incorporation of the Citizens' Electric company.

S. P. Baird is representing the Ball automatic high speed engine. He reports the prospects flattering for the sale of several large engines for use in St. Louis and vicinity.

J. H. Irwin, secretary and treasurer of St. Louis Western Electric Light company, has returned from Pennsylvania, where he has been enjoying his vacation.

John Farmer, an electrician in the employ of the St. Louis Western Electric Light company, has designed and is building a dynamo of the Gramme ring type which utilizes over 90 per cent. of the wire on the armature.

The exchange of the Missouri Bell company is in excellent running order. This company does its work both inside and outside in a very workmanlike manner. B.

Indianapolis Items.

Indianapolis, Ind., August 17.—During the last week the Jenney Electric company of this city has been putting in a 200 arc light plant at Nashville, Tenn., for E. T. Noel. This company also furnished the plant of 80 arc lights for the "Fall of Babylon" at Cincinnati.

A cross between two electric light wires, in an out-of-the-way place, last night, caused a run for the fire department in which one of the chemical engines was badly wrecked and one of the horses disabled by getting into an unprotected gas trench.

There is a fair prospect for more light for this city. A meeting of business men has been called to take some action toward making a display of the city's natural gas advantages. Arches over the principal streets and private lights in front of business houses are talked of. M.

THE ELECTRIC LIGHT.

The Charleston, S. C., Electric Light company will probably enlarge its plant shortly.

The Fostoria Electric Light company, Fostoria, O., has been organized, with a capital stock of $25,000.

The Athens Gas Light company, Athens, Ga., is considering the subject of erecting an electric light plant.

The Gas company of Arkansas City, Mo., has ordered a thirty-five arc plant of the Thomson-Houston company of Chicago.

The North Chicago Street Railway company has ordered a fifty arc light plant of the Thomson-Houston company of Chicago.

The Brush Electric Light company of Baltimore, Md., will, it is reported, erect a new plant of about 5,000 horse power capacity.

The Rome Gas Light company of Rome, Ga., is remodeling its gas works, increasing its capacity, and putting in an electric lighting plant.

The Thomson-Houston company of Chicago has sold a plant of thirty arc lights to the Salina City Gas & Water company of Salina City, Cal.

A plant of twenty arc lights has been sold by the Thomson-Houston company of Chicago to the Omaha and Council Bluffs Bridge & Railway company.

The Walla Walla, W. T., Territorial penitentiary is to be lighted by electric light. Four hundred and eighty sixteen-candle power lamps will be employed.

The authorities of Buenos Ayres have approved the statute authorizing the formation in that city of the Edison Electric Light company, with a capital of $500,000.

The United States Incandescent Gas Lamp company of Ashland, Ky., has been chartered by William Londerrach, C. W. Schofield and others, with a capital of $100,000.

Read's hotel at Chattanooga, Tenn., is being equipped with 500 incandescent lights of the Mather system. J. H. Reid, western manager of the company, is making the installation.

The Duluth, Minn., Electric company, capital $150,000, has been incorporated by Otto C. Hartman, Alexander W. Hartman, C. E. Van Bergen and Franklin R. Anson, all of Duluth.

The Northwestern Electric Supply & Construction company of Seattle, W. T., has contracted with the Northern Pacific to light Stampede tunnel. There will be used 300 30 candle power lights.

The Natchez, Miss., Gas company has acquired the right to manufacture and sell electricity. This company, instead of enlarging its gas plant, proposes to enlarge the scope of its work by adding an electric light plant.

The Oregon City, Ore., Electric Light company, with a capital of $20,000, has been formed. Those interested in the company are, M. A. Stratton, T. L. Charman, E. L. Eastham, F. O. McCown, T. Charman.

The Natchez, Miss., Electric Light, Heating & Power company has been organized. All the stock has been taken, the plant ordered, and the works are to be in operation by the 1st of October at the latest. The Van Depoele system is the one adopted, and only arc lights will be put in at first, but will be followed by the incandescent if demanded.

The Fort Wayne Jenney Electric Light company has established an office in St. Paul, Minn, at 352 Drake Block. It will be in charge of Walter K. Freeman, a geotleman well and favorably known in Chicago.

The Vancouver, W. T. Electric Light company has been incorporated with $20,000 capital stock. The incorporators are David Wall, L. Sohns, B. F. Shaw, Chas. Brown, Wm. E. Maxson, Wm. S. Patten, John O'Keane.

Martha Moyer has begun a suit to obtain $5,000 damages against the California Electric Light company of San Francisco. It is alleged that the plaintiff stepped on a wire that had fallen from a pole, and was severely shocked.

The residence and grounds at George M. Pullman's country house at Thousand Island Park are lighted by electric light. The power house contains a forty horse power engine with a sixty horse power boiler and two dynamos.

Electric lighting has been successfully tried on the Skane-Holland railway, in Sweden. The lamps are fed from an accumulator in the luggage van. It is intended to fit all the express trains with the system between Christiana and Helsingborg.

The Heisler Electric company has secured patents in Belgium, England and Italy for its system of lighting, and is expecting the same favor to be accorded it in Germany and Austria at an early date, when work in the foreign field will be at once begun.

The Grand Ledge, Mich., common council has voted to purchase an eighty horse-power engine of the Lansing Iron and Eugine works to operate its electric light plant. Grand Ledge people have had a great deal of trouble with their street lamps owing to insufficient power.

In the thunderstorm at Montreal, August 18th, all the electric lights extending from the foot of McGill street to Hochelaga were instantly extinguished, as were also the electric lights on the canal. In the electric light station the electrician and his assistant were benumbed by the shock.

The Heisler Electric Light company has contracted to furnish the Grand Junction, Col, Telephone company with a plant of 500 lights, and the Pueblo, Col., Gas Light company with one of 1,000 lights. Hackettstown and Ocean Grove, N. J., have just been lighted with the Heisler system.

The Pike Electric company will supply the St. Charles, Mo., Car company with a lighting plant of sixty-three arc lights—American system. Among recent sales of the Cleveland electric motor, is a 5 horse power sold to the Cable Electric company, for pumping water at Kensington Gardens.

Since the consolidation of the Hauss and Brush Electric Light companies the plant of the former, which will operate all the incandescent lights, has been undergoing repairs, and is now complete in every respect, and the machinery will be put in motion to-night, says the Chattanooga *Evening News* of August 1st. A fuel gas furnace has been added to this plant, which will decrease considerably the item of fuel. They have a capacity of 2,000 lamps and a force large enough to make every lamp satisfactory.

The electric light is to be removed from the court house in Rochester, N. Y., on the ground of economy. Gas is to be used hereafter. Naturally enough the court house officials feel aggrieved. One of them is quoted as saying: "We shall have to use twice the number of gas burners that we do electric lights, and in a small room like the county clerk's office or treasurer's office, the gas consumes as much oxygen as the people. While we had electric lights there have been no complaints of headache, dizziness and a general feeling of sickness."

Judge Colt has handed down a decision in favor of the plaintiff in the case of the Thomson-Houston company of Boston against the Citizens' Electric company and others. The action was for infringement of letters patent No. 238,315, granted Elihu Thomson and Edwin J. Houston. The main defence was that the prior patent, No. 223,659, which was issued to the complainants, was an anticipation of the patent sued upon. Judge Colt in his decision said: "Upon the subject of infringement I have no doubt. The question is not as to the form of dynamo the defendants may use, or whether their machine may be adjusted by hand to avoid sparking, but the question is whether they use the complainant's invention by the employment of substantially the same means to accomplish the same result, namely, the regulation of the current by means of a device responding to changes in the main or generated current, and this the complainants have shown."

The *Progressive Age* believes in the adoption by gas companies of electric light in conjunction with gas plants. In an article explaining its position that paper says: "Taking common current report as it comes to us from individuals, the local papers and class journals throughout the country, and in divers other ways, we obtain the belief that, as a rule, the furnishing of electric light is a profitable undertaking when the community to be supplied is large enough to afford a reasonable patronage, and the work is conducted on prudent business principles. The electric light is certainly no longer an experiment, though yet susceptible of many improvements, but the same things can be said equally of gas. Both are here to stay, and those who kick against the electric light may as well make up their minds that they are kicking against the pricks. So far as the effect on gas is concerned, the testimony is on every hand that the introduction of electric light, instead of diminishing the use of gas, tends to extend and increase the consumption of it. Evidence of this kind comes to us daily from gas works and is to be found in every issue of this paper. In the light of these and other facts as they are known to exist, it seems the height of foolhardiness to seek to ostracize electric light. It is as inevitable as it is good, therefore better accept the situation gracefully, make money with the other fellow's capital, and avoid the experience of the bull with the locomotive."

THE ELECTRIC MOTOR.

Work for the experimental electric railway between Wethersfield and Hartford, Ct., was begun last week.

The Sprague Electric Railway and Motor company have been awarded the contract to equip the Cleveland, O., electric road. This is to be a very complete equipment, consisting of eight miles of track and sixteen cars, iron poles, etc.

G. W. Morgan and others and Nathan Cole, jr., have petitioned the Los Angeles, Cal., trustees for an electric railroad franchise, to build a road from Franklin and New High streets to Pasadena The storage battery system will be used.

The West End Railway company of Boston, which has decided to employ the electric system, will immediately equip twenty cars. Overhead wires will be employed, but a conduit will be built on those sections where the overhead system is prohibited.

A company has been formed in Des Moines, Ia., with a capital of $100,000 for the manufacture of the Wells electric motor, for the purpose of building and operating electric motors and leasing the same. Jesse Wells, of that city, is the patentee, and the incorporators of the company are R. N. Bayless, Jesse O. Wells, Samuel Merrill, H. E. Teachout, Wm. M. Lamphere, Albert T. Hess and David H. Ogden.

It is safe to say that the Westinghouse Electric company has a gold mine in its new electric motor, says the Pittsburg *Post*. The public, even the electric public, has not yet reached a realization of the importance of the invention. The motor was invented by Nikola Tesla, a native of Lika, a town on the border line of Austria and Hungary. He was educated in Austria and graduated as a civil engineer. Electricity soon claimed his entire attention, and now though apparently less than thirty years of age, he has a very wide reputation as an electrician. The Westinghouse has contracted for his patents on the new motor, and he has been in the city several weeks proving all he claims for his invention. When the company is satisfied the contracts will be signed.

If in a district the normal number of horses using the streets is, say, five thousand, and these be reduced one-half by the use of electricity, then the wear and tear due to the tramping of these horses is saved, and it is no stretch of the imagination to say the life of the streets is doubled, while the cost for cleansing the streets is reduced, says the London *Electrical Engineer*. Unfortunately, few people consider these indirect advantages. Most of us only understand direct advantages, and anything that puts a shilling into our pockets is appreciated, and will be heartily supported; while that which only helps by not taking out a shilling is lost to sight. Still, a few enlightened folk do recognize such advantages, and their support gradually brings with it that of their less thoughtful neighbors. Every effort, then, should be made by those interested in this branch of electrical engineering to see that those with whom they are brought into contact fully understand both direct and indirect advantages.

There was considerable excitement for a few moments yesterday afternoon in a Madison street candy shop, says a Chicago paper. The proprietor has recently introduced a couple of those windmill fans which are operated by an electric current and guaranteed to reduce the temperature. At rest they are harmless looking machines, but when they are allowed to flicker they make more revolutions in a minute than occur in Venezuela in six months. This candy man believes in them, and has one in operation at each end of his soda water counter all of the time. Well, yesterday afternoon a stranger wearing a white plug hat came in with a lady and ordered two vanilla-and-creams. They took seats near one extremity of the mottled marble, and the gentleman, true to the observances of polite society and fully alive to the sultriness of the atmosphere, removed his hat. When the sodas were served he placed his hat upon the electric fan. There was a sound like a butcher sawing through a ham, and the remains of a white plug hat shot in a shower across the room and fell among the caramels. The only section of the headgear remaining intact was the sweat-band. After the astonished stranger had regained consciousness the candy man sent out for a new hat and then hung placards over the fans: "Not responsible for hats or coats."

Electric motors for low power purposes are becoming more and more prominent, says the *Metal Worker*. In connection with our recent brief reference to their position in the list of domestic motors, it is of interest to note that they are now made to be operated either by a small battery of a few cells or by a current from an electric light wire, and are capable of successfully performing work for which steampower would be objectionable. For some years the manufacture of electric motors was in an experimental stage, as usual in the opening up of all new enterprises, but by this time the difficulties seem to have been overcome, and those desiring to use electric motors have a number of patterns from which to make a selection. Prices also have become more reasonable, with increased competition and the progress toward greater perfection made through the increasing attention given the subject. The motors can be started, stopped or reversed by a small lever, which instantaneously controls the motion. Jewelers' and dentists' lathes and drills and similar delicate machinery need a motor of this character, which not only operates at a high rate of speed, but can be instantly stopped and reversed if desired. Sewing machines are a class of machinery to which these motors are well adapted. The battery is placed in the cellar or in the closet out of the way, from which wires convey the current to the motor placed on the table of the machine. It is always ready for use, and when not actually in use it requires no attention to keep it in order beyond an occasional recharging of the battery. Pumping machinery for domestic supply in suburban towns is another field in which these motors can easily be employed with great comfort, benefit and convenience, as any resident of the suburban districts can testify who has been obliged to pump by hand.

THE TELEPHONE.

The telephonic communication between the Brussels Exhibition and Paris is not giving satisfaction so far, the want of success being attributed to unfavorable meteorological conditions.

The American Telephone Sonoretta company of Chicago has been incorporated. The capital stock is $50,000; The incorporators are Charles S. Clark, George L. Lavery, F. S. Baker, Charles W. Morehouse and N. W. Hartwell.

The committee on fire and water of the New Orleans city council finds that aproposed ordinance reducing the telephone charges from $96 to $50 cannot be reported favorably, as it believes the city has no power to regulate the charges.

An injunction has been obtained by the Southern New England Telephone company restraining the Norwalk and South Norwalk, Conn., Electric Light company from further erecting wires and poles in such a way as to cause induced currents on the wires of the telephone company.

The New Jersey Court of Errors and Appeals has decided the case between the Domestic Telephone and Telegraph company of Newark, N. J., and the Metropolitan Telephone and Telegraph company of New York and the New York and New Jersey Telephone company. The decision is in favor of the Domestic company. During the progress of this suit, the original stockholders of the Domestic company sold out to parties friendly to the New York and New Jersey company, so that latterly the case has been continued as a matter of principle, and for reasons entirely different from those governing when the suit was commenced.

The Kansas City Telephone exchange bears the reputation of being one of the best exchanges in the country, and under the vigilant eye of Wiley W. Smith, general superintendent, the service is constantly improving. In order to keep record of the number of connections each operator makes, he has recently placed at each switchboard a registering device which automatically makes a record every time a connection is made. The apparatus in action to some extent resembles the clock used by watchmen. The cost for the clocks was small, and that for maintenance is practically nothing, as the transmitter battery is used for operating the system. At appointed hours the paper record is removed from each clock and a new blank is placed in position. The record has a great value in its exhibition of what is being done during any hour or fraction of an hour in the day.

The rival telephone companies in Montreal continue their hostilities. The Federal company raised their poles to fifty feet so as to be able to cross the Bell wires at the corner; the Bell company then raised their poles just as high and strung some twenty dead wires so as to impede the Federal from crossing. Mr. Gauthier, assistant superintendent of the city fire alarm department, stated that the right of way at that corner belonged to the city, which had delegated it to the Bell company under condition that the latter would string the alarm wire above all others, as the circuit might be broken at any time if one of the other wires should touch the alarm wire, thus exposing some $20,000,000 worth of property which was protected by that particular wire. Officers of the Bell company also testify that it was in consequence of this contract with the city that they had tried to overcome the Federal wires.

THE TELEGRAPH.

A dispatch from Baltimore, August 15th, says: "The report circulated in Wall street, New York, yesterday that the Baltimore & Ohio company had determined to part with the five millions of Western Union stock received in payment for the Baltimore & Ohio Telegraph lines is denied here by the officers of the railroad company."

H. A. Stares, representing the Western Electric company, has been engaged to lay a new telegraph cable between Astoria, Ore., and Fort Canby, in place of the one broken two years ago by a vessel dragging its anchor. It has been found impossible to find the old cable, as it seems to be covered by the sand. The new cable will be laid at once.

The people of Corea are enterprising. A line of telegraph is to be made to join the capital with Fusan, taking in several large towns on the way. The poles for this line have been imported from Japan, and the other materials from Germany. The king's palace has been furnished with Edison's electric light, and this has been found better and more economical than candle and kerosene.

Fanny Vaughn, the 16-year-old daughter of Sheriff Vaughn of Richmond county, New York, is taking lessons in telegraphy and has an instrument in her home at Richmond which is connected with the wires that run through the town. During the thunderstorm on Friday evening lightning ran into the house on the wire and struck her 3-year-old brother who was seated near her in a high chair. Both he and she were thrown to the floor. The child was stunned, but it soon recovered. A deep red mark was left on his right hip and instep.

Miscellaneous Notes.

The Harding Electrical Manufacturing company of San Francisco, Cal., has been incorporated with a capital stock of $1,000,000.

Electric wires are being laid underground in chemically coated wooden channels, from the gas house on Stevenson street, near Fifth Street to the Baldwin hotel, San Francisco.

Gov. Hill of New York recently said: "The noose has always seemed to me an unnecessarily brutal device, and I have been glad therefore to sign the act substituting electricity. The quickness and certainty of the new method will obviate all chances of those awful miscarriages which have attended executions on the scaffold. I believe that we have made a humane step forward in this adoption of electricity in capital punishment, and I have no doubt at all that we will be followed by governments the world over."

Col. Gourand, representing Mr. Edison, gave an exhibition at his residence in Norwood of the inventor's loud-speaking phonograph, says a cablegram from London. A number of journalists and many persons prominent in art and literary circles were present, and all were astounded at the results obtained.

A terrific thunderstorm passed over this city between 7 and 8 o'clock last evening, with the heaviest rain seen here for many a year, says a dispatch of August 17th, from Aurora, Ill. Lightning struck a street car, singeing the arm of a lady passenger, severely shocking the driver, and damaging the car slightly. The woman was not seriously injured.

At the annual meeting of the Calumet and Hecla Mining company held at Boston, August 15th, the following directors were chosen: Alexander Agassiz, Cambridge; Quincy A. Shaw, Boston; George Higginson, Boston; H. H. Hunnewell, Boston; James N. Wright of Michigan. At a subsequent meeting of directors Alexander Agassiz was re-elected president, and C. W. Seabury, treasurer.

A New York dispatch dated August 17th, says: "A company of western men, with Hamilton S. Wicks of Kansas City, at their head, have secured a contract with the syndicate controlling the Edison-Bell graphophone for all rights within the territory west of the Mississippi and east of the Rocky Mountains. Exchanges are to be established and the instruments introduced in the leading cities of that district by the first of October."

Business Mention.

The okonite insulated wire and cables for electric light, telegraph and telephone purposes, manufactured by the Okonite company, 13 Park Row, New York, are daily increasing in popularity. They are claiming much attention in Europe, where several tests have been made by Dr. John Hopkinson, F. R. S., with the most flattering results.

The writer was present at the test recently made of Wright's Armature Protector at the station of the Chicago Arc Light & Power company, and the protector certainly does all that is claimed for it. A larger machine was short-circuited, but the protector acted promptly, and the machine ran right along as though nothing had happened. This protector will make its merits appreciated wherever introduced.

The Shultz Belting company of St. Louis, has just made and put into the plant of the East River Electric Light company, New York city, one of the largest belts ever made west of New York. It is 123 feet long, 58 inches wide and weighs 1,300 pounds. It is made of double leather, is to transmit 1,000 horse power, and takes the place of an oak tanned belt. The company made the belt, delivered it in New York and had it transmitting power inside of six days. This speaks well of the fulled leather belting made by this company. This belt was cemented only. No pegs or rivets were used.

One of the most important acquisitions to the East End is the large and flourishing D. M. Steward Manufacturing company which was induced to remove its business from Cincinnati to a much finer and more convenient location here, by the flattering inducements offered by the East End company, says the Chattanooga *Evening News*. They gave the concern a splendid building site and subscribed liberally to the company's stock, making the terms so attractive that the plant was moved to this city and a fine brick factory erected on the land donated by the company. The business of this firm is a most unusual one, that of the manufacture of lava gas tips, slate pencils and all manner of goods to be made out of soapstone. The concern employs a large number of hands and is an important addition to the city in many respects.

The manufacture of rubber fabrics for mechanical purposes is one of the most important industries in America. No other field of manufactured goods except that of iron is more extensive, and none perhaps is of greater importance. Among the largest concerns in this line, if indeed it is not the largest in America, is the New York Belting and Packing company, whose main offices are at 15 Park Row, New York, and whose factories, which are the most extensive in the world, are located at Newton, Conn., and at Passaic, N. J. Nearly forty years have been spent by this company in perfecting the manufacture of vulcanized rubber for mechanical purposes, during which time many valuable patents have been issued to them, covering different processes incidental and indispensable to the manufacture of their leading specialties. The business of the vast concern is conducted by John H. Cheever, treasurer of the company, a gentleman of great intelligence, experience and tact. John D. Cheever, a son, as deputy treasurer, shares with his father the great responsibilities of a business running into many millions. In the same building is located the Okonite company, in which the Messrs. Cheever are largely interested, and which is under the management of President Chas. A. Cheever, a man of great experience, covering many years in an active connection with important electric light, telegraph and telephone enterprises. He is ably assisted by Captain Willard L. Candee, who is treasurer of the company, and whose evidence in electrical matters, as an expert, is recognized as among the best in the country. Captain Candee has an associate, Geo. T. Manson, a gentleman widely known among business men and greatly admired for his open, genial disposition and many high social qualities. L. A. Sneden is the able secretary. The company's manufactures embrace plain and braided wires for telephone, telegraph and electric light purposes, armored wires, submarine cables, the Candee aerial wires, flexible electric light wires, incandescent lamp cord and the famous Okonite waterproof covering for making joints.

Personal Paragraphs.

David Chalmers, representing the Empire City Electric company of New York, spent a day in Chicago last week.

Wiley W. Smith, general superintendent of the Kansas City Telephone exchange, was in Chicago a few days last week.

Dr. Benjamin Franklin Goodrich, president of the B. F. Goodrich company and the Goodrich Hard Rubber company of Akron, O., died August 3d. This intelligence will be received with sadness by a large circle of friends and business acquaintances.

Electrical Patents.

Issued August 14, 1888.

387,642. Galvanic Battery. Ernest M. Hewett, Boston, Mass.

The first claim follows: "In a galvanic battery, infusorial earth or a similar absorbent substance, sulphuric acid, water, and bisulphate of mercury, in combination with a jar, a zinc plate, and a carbon plate."

387,643. Galvanic Battery. Ernest M. Hewett, Boston, Mass.

387,645. Multiple Switch Board. Milo G. Kellogg, Hyde Park, Ill.

The invention consists in a multiple switch-board system of operating an exchange and testing any board to determine whether a given line is in use and in certain apparatus and circuits for operating said system.

The first and last claims are given: "1. The combination, with a pair of flexible conducting cords and their plugs for connecting two subscribers' lines, of an operator's telephone, a clearing out annunciator, and a switch, said annunciator being in the circuit of said cords and said switch having contact points to switch said telephone in and out of the circuit of the cords, and other contact points to shunt said annunciator by a circuit of small resistance, of which the telephone is not a part, when said telephone is switched into the circuit of the cords."

"9. The combination, with telephone lines and two or more switch boards, at each of which said lines may be switched for conversation, of pairs of test bolts for each of said lines, one pair on each of said boards, one bolt of each pair being connected to the circuit of the line outside of and on one side of its line switches, the other bolt of each pair being connected with its corresponding bolts on the other boards adjacent to the point of the switch of its line at its board, connected to said first mentioned bolt and crossed with said point by the switch plug on its insertion, and sets of testing apparatus, one set at each board, each set consisting of a test receiving instrument and a battery in a loop, and means for connecting the two sides of the loop to the two test bolts of any pair of test bolts at its board."

387,654. Jar for Galvanic Batteries. Bernard Overlack, Boston, Mass.

387,679. Electrolyte for Galvanic Batteries. Derick H. Fitch, Cazenovia, N. Y.

The claim is given: "Muriatic or chlorhydric acid in connection or combination with the solution for galvanic batteries, made by dissolving chloride of ammonium and chlorate of potassium or chlorate of sodium together in water."

387,703. Circuit Closer for Electric Clocks. Charles D. Warner, Ansonia, Conn.

387,704. Electric Clock System. Charles D. Warner, Ansonia, and Arthur D. Bennett, New Haven, Conn.

This invention relates to those systems in which a clock is arranged to open and close an electric circuit containing and operating electric secondary clocks.

The first claim follows: "1. In an electric clock system, the combination of a secondary clock circuit, a regulator for operating the same, and an alarm circuit connected with said secondary circuit, and rendered inoperative by the working thereof, whereby the alarm is prevented from sounding during the normal action of the secondary clock circuit and sounded when their action becomes abnormal or ceases."

387,714. Electric Motor. Bradley A. Fiske, U. S. Navy.

The first and last claims are given: "1. The combination of a movable body, a rotary electric motor gearing whereby the rotation of said motor moves said body, an arm movable independent of said body and adapted to be moved by hand, a circuit controlling switch carried by said body and operated by said arm, and electrical connections between said switch and said motor, such that when said arm is moved, said movable body is moved so long as the movement of the arm is continued.

"5. The combination of a movable body, a rotary electric motor, gearing whereby the rotation of said motor moves said body, an arm movable independently of said body, and adapted to be moved by hand, switch contacts carried by said movable body, and switch contacts controlled by said arm, and electrical connections from said switch to the motor, such that at the central position of the arm the motor circuit is broken, and on its movement in either direction circuit is closed to the motor, so that it moves said body in the same direction, following the movements of the arm, and on a more rapid movement of the arm the speed of the motor is increased."

387,718. Telephone Support. Newton W. Hartwell, Louisville, Ky.

The second claim runs: "2. A telephone support comprising a standard, adapted to be attached to the telephone case, a bar pivotally connected thereto, and a rest attached to said bar to hold the receiver and provided with a flaring ring, serving the double function of holding the receiver on the rest, and a sound insulator."

387,732. Electric Cut-Out. Joseph A. Powers, Lansingburg, N. Y.

387,839. Galvanic Battery. Granville T. Woods, Cincinnati, Ohio.

The first and last claims are appended: "1. The improved galvanic cell embodying the negative electrode arranged as an annulus concentrically around the positive electrode, and an intervening insulating shield, in combination with the containing vessel and exciting liquid.

"3. A galvanic cell embodying a carbon or negative electrode, combined with an open insulating annulus, around which it is secured as one removable structure and the zinc or positive electrode, combinedwith an insulated bridge which is suspended upon and within the insulated annulus, also as a removable structure, the whole combined with and arranged within and upon a containing jar."

387,842. Automatic Coin Controlled Ticket Printing Weighing Scale. Edward H. Amet, Chicago, Ill.

387,853. Regulator for Dynamo Electric Machines. Charles L. Buckingham, New York, N. Y., and Hermann Lemp, Hartford, Conn.

The object of the invention is to employ the movement of a magnetic bar placed under the control of the lines of force of a magneto electric machine to shift or adjust the commutator brushes to a non-sparking position. The brushes are first properly adjusted for a certain electrical condition of the machine, when the magnetic bar is mechanically joined to said brushes. Thereafter with each shift of the lines of magnetic force, and the corresponding displacement of the magnetic bar, the brushes will be changed and adjusted to a non-sparking position.

The first, fifth and eighth claims are appended: "1. The combination, with a rotating armature and its field of force magnets, of a magnetic body arranged adjacent thereto within the magnetic field of the armature and field of force magnets, and controlled by the resultant of the forces of the armature and field magnets, and connections for shifting the commutator brushes, through the instrumentality of said magnetic body, to correspond with the shifting of said resultant.

"5. The combination, in an electrical machine, with its rotating armature and field of force magnets, of a magnetic bar arranged adjacent thereto, within the magnetic field of the armature and field of force magnets, and controlled by the resultant of the forces of the armature and field magnets, intermediate connections for shifting the commutator brushes, through the instrumentality of said bar, to correspond with the shifting of said resultant, and a dash pot or other means for steadying the movements of the aforesaid parts.

"8. The method of regulating the position of the commutator brushes to keep the same at the maximum point in an electrical machine, thereby securing efficiency and preventing sparking, consisting of causing a magnetic body to be governed by the varying resultant of the magnetism of the armature and field magnets, and thereby controlling the position of the commutator brushes."

387,876. Process of Preparing Aluminum Bronze and other Alloys. Paul Heroult, Lauffen-Uhwiesen, Switzerland.

387,888. Multiple Switch Board. Milo G. Kellogg, Hyde Park, Ill.

The second and third claims are given: "2. A spring jack switch containing a contact point or piece, a spring lever normally bearing on said contact point, and two insulated contact pieces, all mounted on an insulating strip, said lever being transverse to the front of said strip, said strip having through its front a transverse rectilinear hole in front of said lever, said insulated contact pieces being mounted on one of the faces of said hole and extending to or near the front of said hole.

"3. In a multiple switch board, the combination of a series of line switches, a series of test bolts, one pair for each switch, insulated from each other and from the switch, continuous circuit connections between the similar test bolts of the different boards, circuit connections between the switches, plugging devices for connecting the subscribers' lines at the switches and for simultaneously crossing the test bolts at the plugged switch, the test plug having double contacts adapted to close the test circuit through the pair of test bolts at the tested switch and through both contacts of the test plug, and a loop circuit, including a battery and signal, connecting with both contacts of the test plug and adapted to be closed through the contacts of the plug, whereby a test circuit is established through the test bolts at both the plugged switch and the tested switch, and through both contacts of the test plug and the signal circuit connected therewith."

387,889. Multiple Switch Board. Milo G. Kellogg, Hyde Park, Ill.

The first claim follows: "1. In a telephone exchange system, two or more multiple switchboards to which the same telephone lines are connected, local test circuits having a pair of contact points or test bolts at the switches, one test circuit for each line, each test circuit containing a battery and connected to each board on each side of the battery, and said battery being normally open, and a switch plug having insulated contacts crossing the test bolts at the connected switches for automatically shunting the test circuit around a tested switch through a line of less resistance when the main line is switched for conversation at another switch, in combination with a test receiving instrument connected on one side to each test circuit at one side of the battery, and a test plug whereby the operator may at will connect the test receiving instrument on its other side to any test circuit at the other side of the battery."

387,890. Multiple Switch Board. Milo G. Kellogg, Hyde Park, Ill.

The last claim is given: "3. In a telephone exchange system, a telephone line, a local test circuit for said line, an induction coil for said line, one coil of which is in the main line and has an intermittent current passing through it when it is not switched for conversation, and the other coil of which is in said local test circuit, a switching device or devices adapted at the will of an operator to switch said line for conversation, and while the line is so switched to cut off said intermittent current from said coil, a test receiving instrument, and a switch testing device or devices adapted to close said test receiving instrument through said local test circuit."

387,932. Flash Light Signal. William H. Thompson, Richmond, Va.

387,974. Electric Clock Synchronizing System. Charles J. Hexamer, Philadelphia, Pa.

The two claims are given: "1. In a clock synchronizing system, the combination of the regulator, the main sectional circuit, the relays connected to the respective sections of said circuit, the local batteries, the synchronizers, and the clocks, together with the electric bells connected to said sections and the switches, the parts being combined, constructed, and adapted to operate.

"2. In a clock synchronizing system, the combination of the regulator, the main circuit composed of a series of sections, the relays connected to said sections, the local batteries, the synchronizing devices, and the clocks, together with the recorder at the end of the main circuit and the electric bells connected to said sections and provided with switches."

387,988. Apparatus for Charging and Discharging Secondary Batteries. Mathias Pfatischer, Philadelphia, Pa.

The invention consists in apparatus for cutting in or out any one or all of the secondary batteries or series of lamps or both, in the outlying district, at the will of the operator at the central charging dynamo station.

The first, third and eighth claims follow: "1. In a system of charging and discharging secondary batteries, the combination of a charging generator having leads running to two or more independent stations with circuit controlling apparatus at each station under the control of an operator at the charging station, said circuit controlling apparatus consisting of rotatable cylinders having electrical contacts for cutting the batteries into the charging circuit, and additional contacts for cutting the lamps into the battery circuit.

"3. In an apparatus for charging and discharging secondary batteries, the combination of two or more switch drums having electrical contacts arranged in a pre-arranged order, and means for rotating said drums together.

"8. In an apparatus for charging and discharging secondary batteries, the combination of charging generator having mains leading to one or more outlying stations containing secondary batteries and lamps or other translating devices, with a switch mechanism at each station for cutting in the batteries or lamps at will, and a differential solenoid or electro magnet having one differential branch in the charging circuit and the other in a normally closed shunt through the batteries."

388,003. Meter for Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

Claim 2 is given: "2. The combination of a rotating armature, an inducing circuit polarizing said armature when traversed by alternating electric impulses, a second inducing circuit receiving currents by induction from the first circuit and polarizing said armature in a different direction, a retarding device applied to the armature, and a counting, registering, or indicating device actuated by the movements of the armature."

388,004. Method of Measuring Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa. Filed June 6th.

The claims are appended: "1. The method of measuring alternating electric currents, which consists in establishing by such currents two distinct lines of alternating polarization, establishing thereby in a movable armature two corresponding lines of alternating polarization of non-synchronous phases, causing the armature to rotate by the mutual attractions of the lines of polarization and registering or indicating the movements of the armature.

"2. The hereinbefore described method of measuring alternating electric currents, which consists in establishing by such currents lines of magnetic force of varying intensity, deriving from said currents other currents, the phases of which differ in time therefrom, establishing thereby polarization in the movable body producing mechanical motion by the mutual attractions between the different lines of polarization, and measuring the amount of such motion

"3. The method of measuring alternating electric currents, which consists in producing by such currents a line of polarization traversing the movable element of an electric meter, establishing by induction from the same current a second line of polarization at an angle to the first, thereby causing the movable element to revolve by the attraction between the second line of polarization and the portion of the first contained in the movable element, and in registering the rotations of the movable element."

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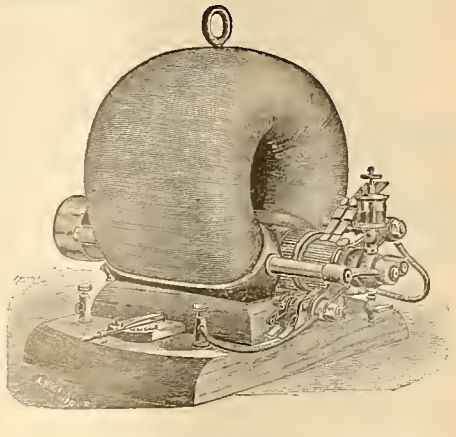

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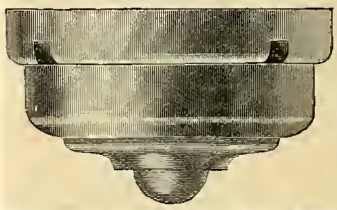
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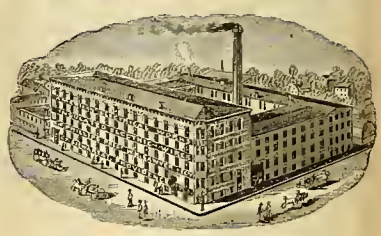
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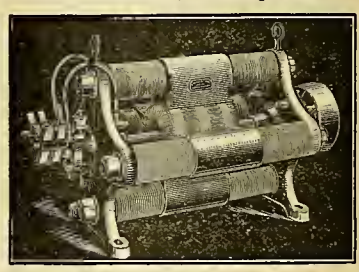
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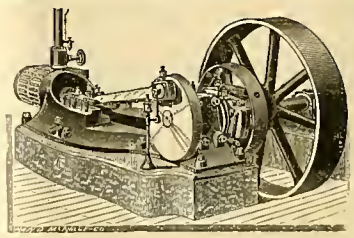

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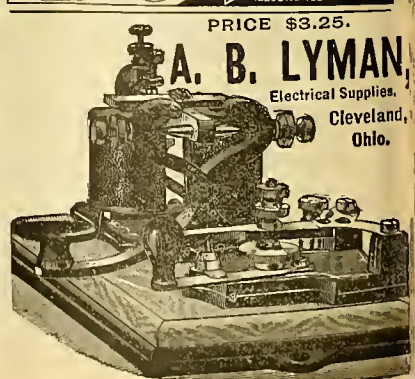

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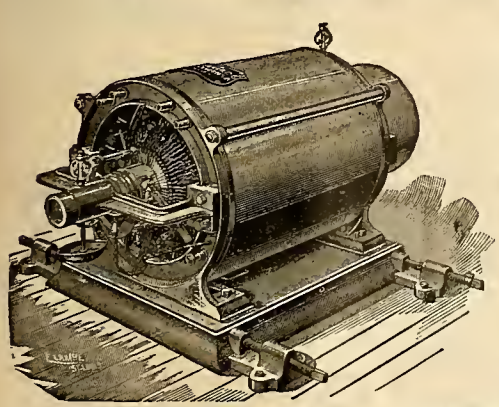

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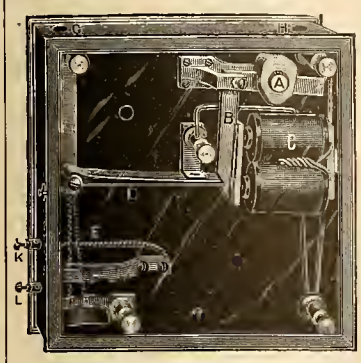

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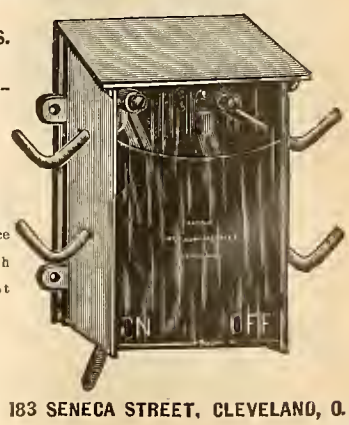

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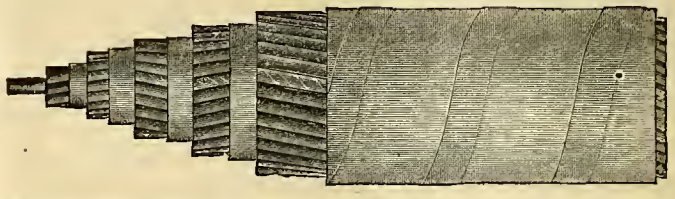

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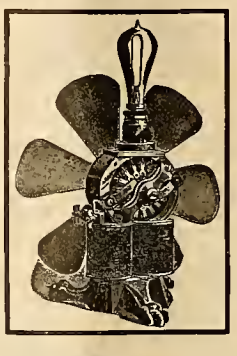

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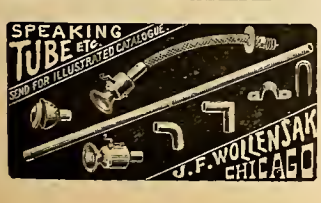

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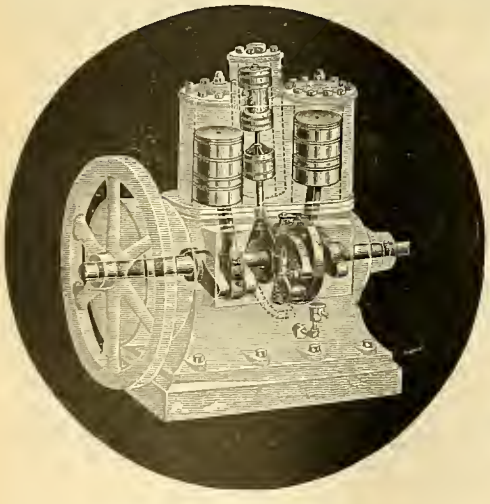

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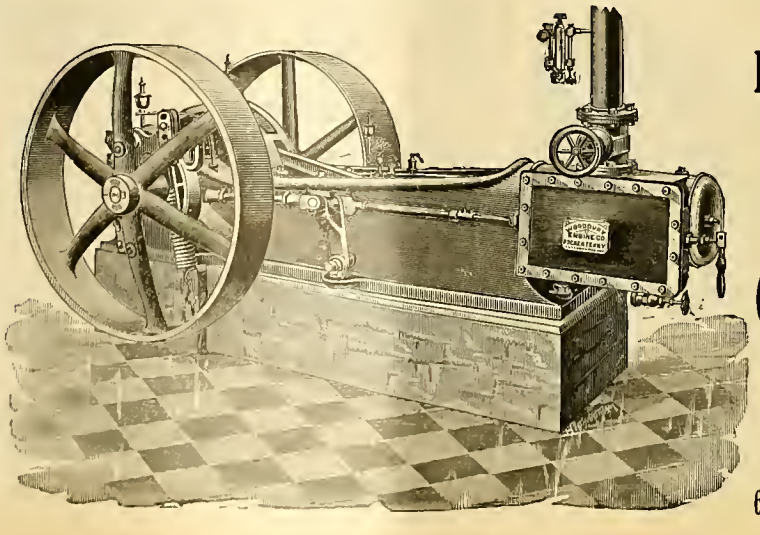

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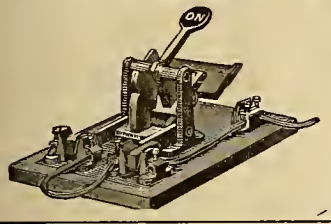

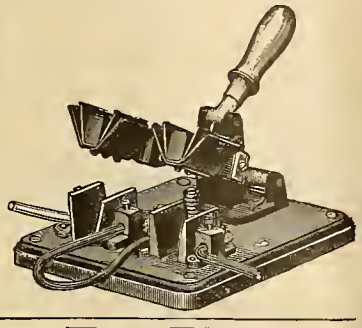

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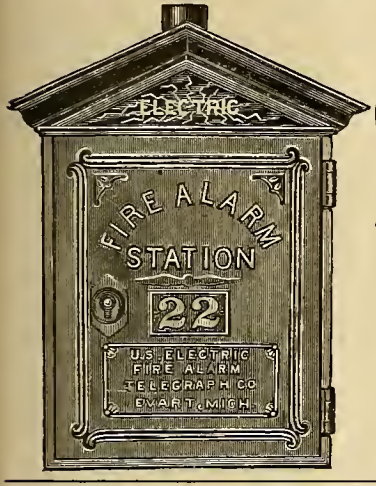

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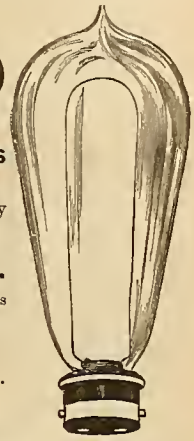

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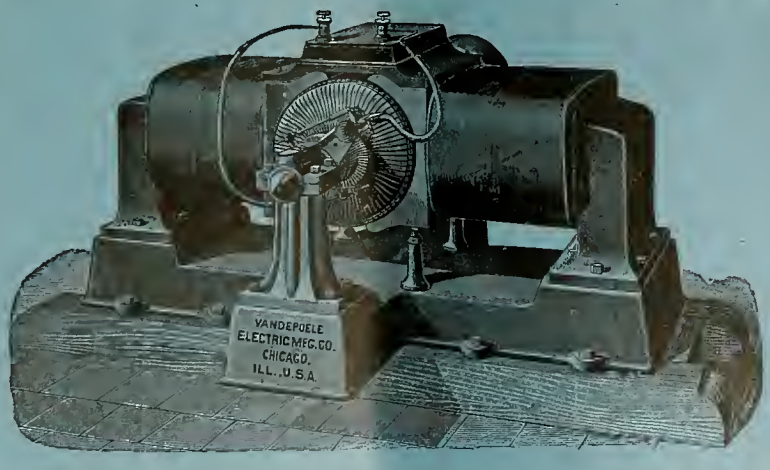

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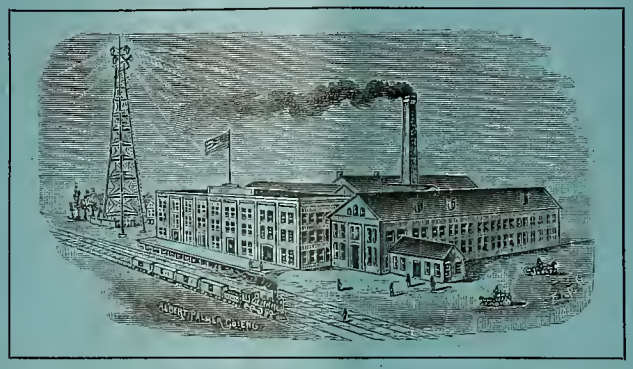

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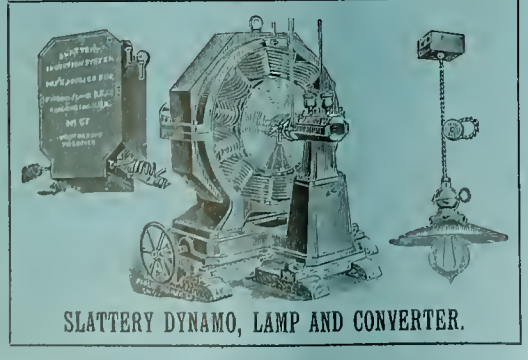

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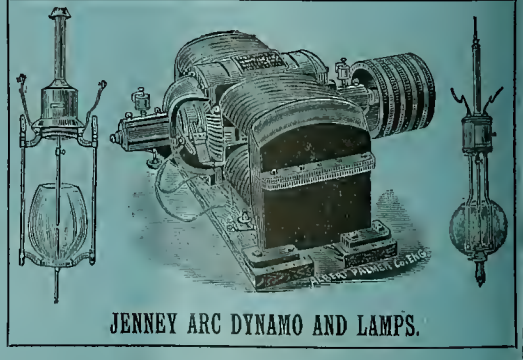

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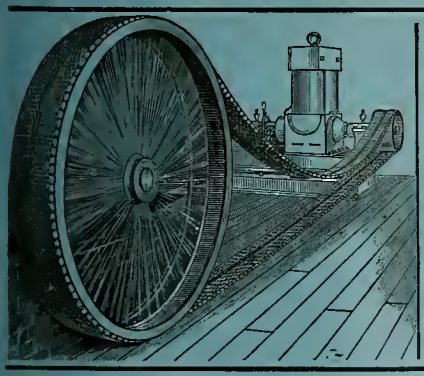

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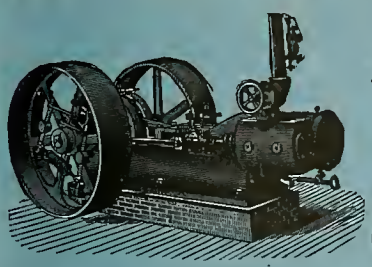

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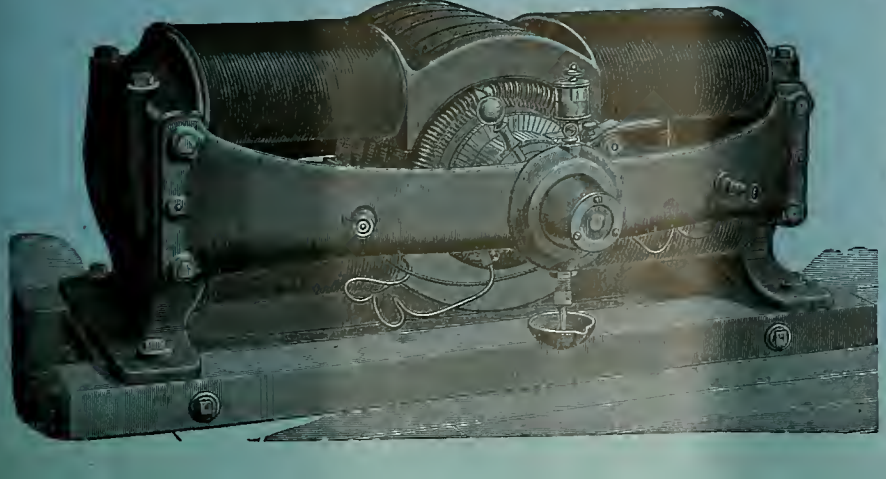

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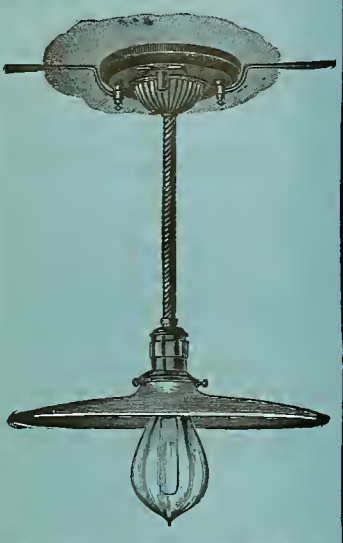

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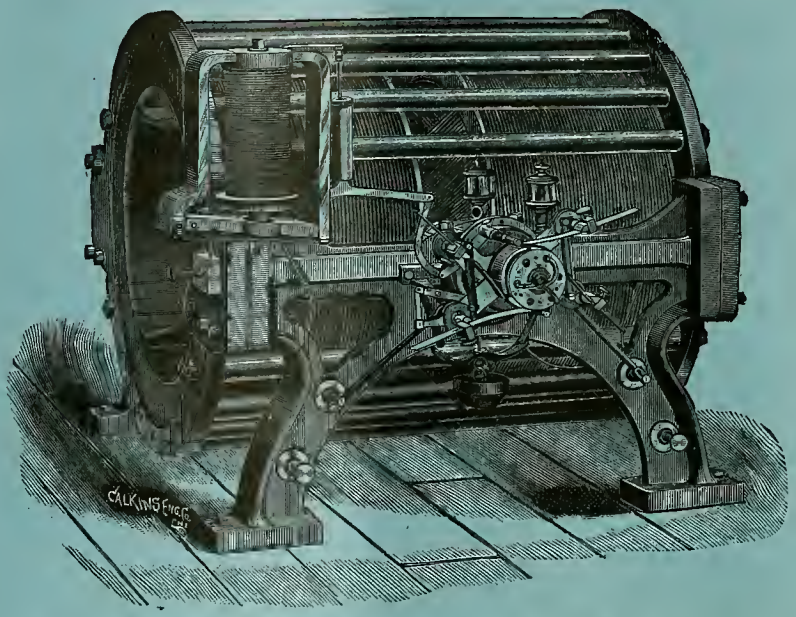

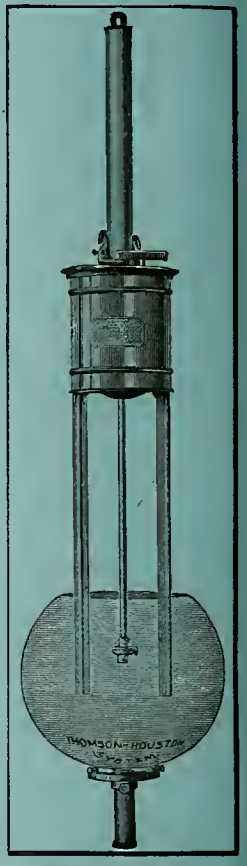

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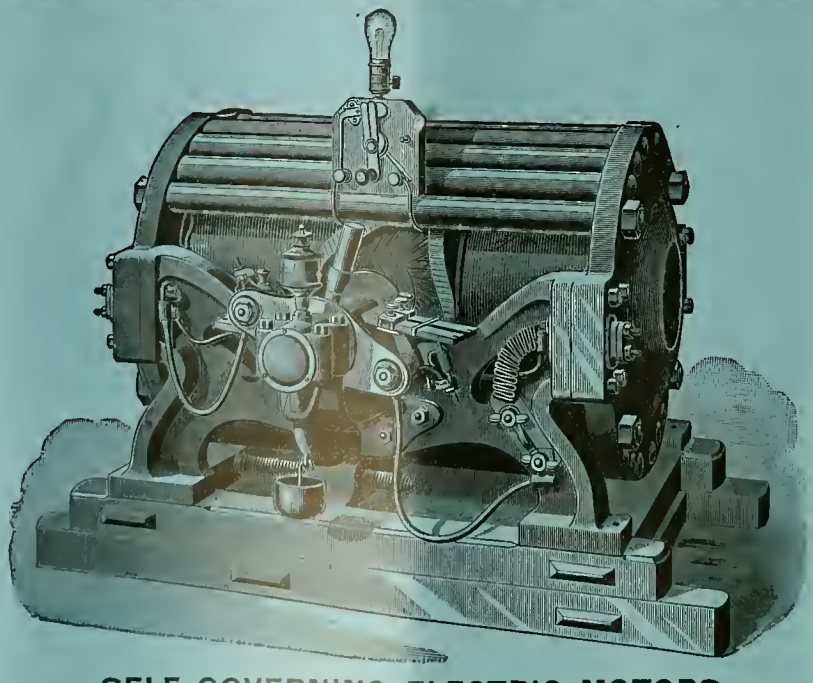

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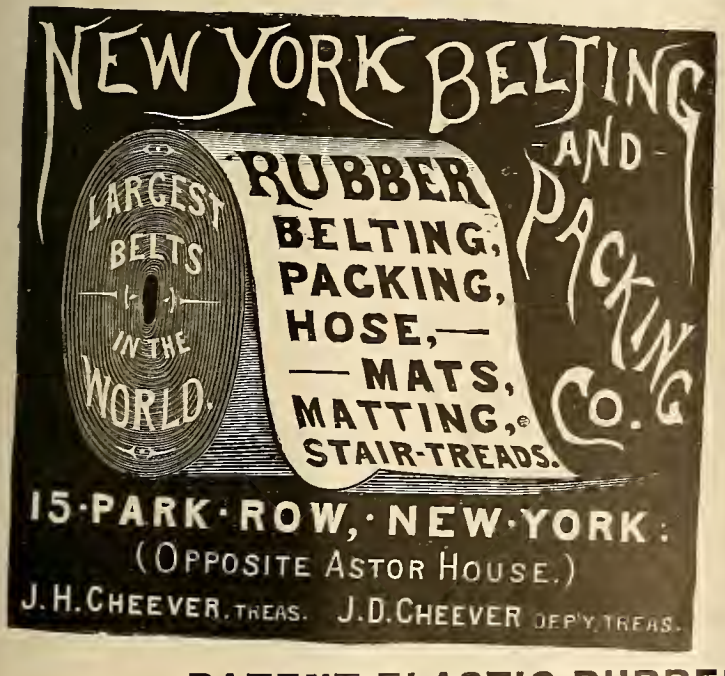

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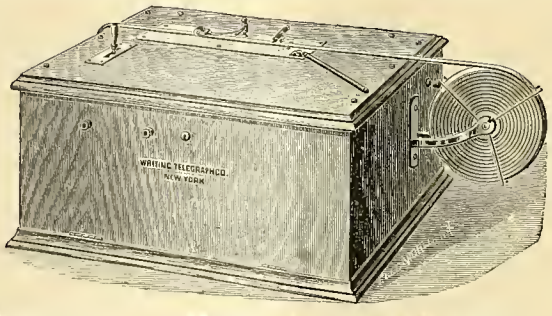

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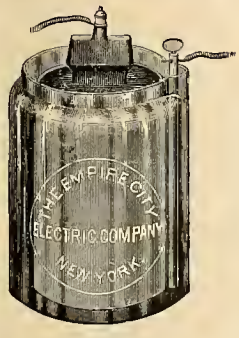

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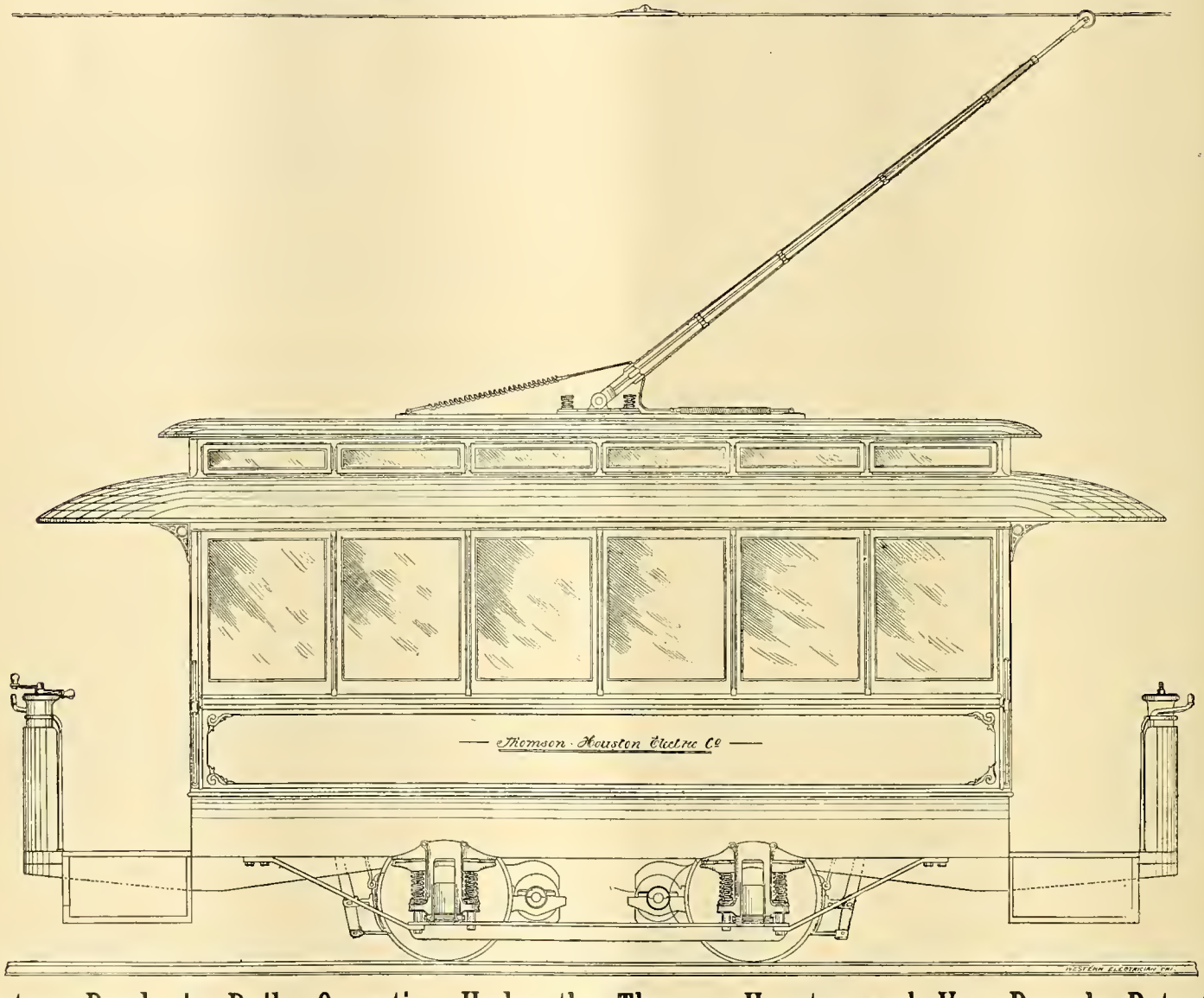

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TABLE OF CONTENTS.

PAGE.

ELEMENTARY DATA—
- The Electric Current, Chapter I ... 1, 2
- Ohm's Law, Chapter II ... 2
- Work, Chapter III ... 2
- Conductors and Insulators, Chapter IV ... 2
- Direction of the Current, Chapter V ... 3, 4
- Detector Galvanometer and Magneto Bell, Chapter VI ... 5, 6, 7

ARRANGEMENT OF POWER—
- The Dynamo Room, Chapter VII ... 8
- Motive Power, Chapter VIII ... 8
- Shafting and Pulleys, Chapter IX ... 9
- Foundations for Dynamos, Chapter X ... 9, 10
- Belts, Chapter XI ... 10

DYNAMO ELECTRIC MACHINES—
- Description of the Dynamo, Chapter XII ... 11
- The Continuous Current Dynamo, Chapter XIII ... 11, 12, 13, 14
  - The Series Dynamo ... 11, 12
  - The Shunt or Derived Circuit Dynamo ... 12, 13
  - The Compound Dynamo ... 13, 14
- The Alternating Current Dynamo, Chapter XIV ... 14, 15
- Preparation of a New Dynamo for Operation, Chapter XV ... 15, 16
- Starting a New Dynamo, Chapter XVI ... 16
- Keeping a Dynamo in Good Order, Chapter XVII ... 12
- Brushes, Chapter XVIII ... 17, 18, 90
- The Commutator, Chapter XIX ... 19, 17

PAGE.

- Repairs, Chapter XX ... 20, 21
  - To the Armature ... 20, 21
  - To the Field Magnets ... 21
- Testing the Wire Coils of a Dynamo for Contact Against Iron, Chapter XXI ... 21, 22, 23, 24

DISEASES OF DYNAMOS—
- Non-generation of Current by the Dynamo, Chapter XXII ... 25, 26
- Excessive Sparking of Commutator and Brushes, Chapter XXIII ... 26, 27

LAMPS—
- Arc Lamps, Chapter XXIV ... 28, 29, 30, 31
- Suspension of Arc Lamps, Chapter XXV ... 31
- Trimming and Cleaning Arc Lamps, Chapter XXVI ... 32
- Incandescent or Glow Lamps, Chapter XXVII ... 32 33
- Multiple Arc System, Chapter XXVIII ... 33
- Multiple Series System, Chapter XXIX ... 33, 34, 35
- Series Multiple System, Chapter XXX ... 36
- Arc and Incandescent Lamps on the Same Circuit, Chapter XXXI ... 36, 37 38
- The Alternating System, Chapter XXXII ... 38

INSTRUMENTS—
- Current Indicator or Ampere Meter, Chapter XXXIII ... 39
- Pressure or Potential Indicator, or Voltmeter, Chapter XXXIV ... 39, 40
- Current Regulator, Chapter XXXV ... 40, 41

PAGE.

- Switches, Chapter XXXVI ... 41, 42
- Safety Devices, Chapter XXXVII ... 42, 43
- Lightning Arresters, Chapter XXXVIII ... 43, 44
- Ground Detector, Chapter XXXIX ... 45, 46
- Switch-Board, Chapter XL ... 46, 47

CIRCUITS OR LEADS—
- Outdoor Leads for Arc Lighting, Chapter XLI ... 48, 49, 50, 51, 52, 53
- Outdoor Leads for Incandescent Lighting, Chapter XLII ... 53, 54
- Arc Circuits Inside of Houses, Chapter XLIII ... 54
- Incandescent Circuits Inside of Houses, Chapter XLIV ... 55, 56, 57
- Size of Wires for Incandescent Lamp Installations, Chapter XLV ... 57, 58, 70
- Testing, Chapter XLVI ... 58

ACCUMULATORS—
- Accumulators, Chapter XLVII ... 59

SAFETY REGULATIONS—
- Rules of the Boston Underwriters' Union ... 60, 61, 62, 63, 64, 65, 66
- English Regulations ... 66, 67, 68
- Abstract of the Chicago Electric Light Laws ... 68, 69

- Table of Electric Light Conductors ... 70
- Lamp Lighting Schedule—Moonlight System ... 71–82
- Construction Tools ... 83-89

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Vol. III. CHICAGO, SEPTEMBER 1, 1888. No. 9.

The Chicago Edison Station.

Early in August, 1887, work was first begun in a vacant lot on Adams street, just east of the Home Insurance building in Chicago, toward building an electric light station on the Edison three-wire system, on a larger scale than any other at that time existing. The foundations consisted of a solid bed formed of iron rails laid in several layers crossing each other and filled in with concrete, and the massive iron framework of the building as it progressed attracted the attention of many passers, and surprise was often expressed at the immense size of the iron columns and beams.

The exceptional severity of last winter delayed the work of building considerably, but with the advent of spring it was vigorously pushed forward and made ready for the reception of the steam and electrical machinery. The entire plant was finished about Aug. 1, 1888, and after some preliminary trials, the electric current was turned on to the underground conductors for public use on Aug. 6. Since that day the machinery has been running continuously day and night, and thousands of bright lamps glowing in stores and business offices, which were before lighted by gas, bear testimony to the ever-growing public appreciation of the light that has come to stay. Among the most prominent places using current from this station may be mentioned the Grand Opera house, the Chicago club, Gunther's refreshment rooms and Thomson's restaurant. The present installation for steam power consists of four Heine safety boilers of 300 horse power each, four Armington & Sims' high-speed engines of 200 nominal horse power capacity each, but which are capable of developing 50 per cent. more, and eight of the largest new style Edison dynamos yet made, and each of which will easily carry a load of 1,250 sixteen candle power lamps, thus making the present output capacity equal 10,000 lamps. The rapidity with which the lights are now being taken up has already induced the company to place orders for two more engines and four more dynamos, which will bring up the capacity of the plant to 15,000 lamps. The building has been so arranged that further steam and electrical machinery can be added as required, up to a final output limit of 45,000 lamps.

The steam plant, which is unusually substantial and well finished in all its details, was designed by F. Sargent, who also personally superintended its erection throughout.

The electrical plant was planned and supervised by W. S. Andrews, who has been closely and constantly connected with Edison central station work for the past five or six years, and whose large and wide experience has enabled him to make an electrical installation as nearly perfect as the present stage of the business permits. Both these gentlemen are to be congratulated that their good judgment and experience have guided them so well, enabling them to complete their work so successfully, and to produce the largest and best equipped Edison electric light station now in existence.

At present the building consists of a basement and two floors, but, as might be inferred, the structure has been so solidly built that the foundation walls and side walls are amply strong to carry as many additional stories as will ever be needed.

The underground copper conductors incased in iron tubes project into the basement of the station, and the solid conductors are then connected to flexible cables that run up to the dynamo room.

The ground floor is devoted to the company's offices and store rooms, and also to the engine room and the lower boiler room.

On the second floor are the dynamo room over the engine room and another boiler room, and the motor room is situated over the offices.

Fig. 1 is a view taken in the dynamo room, showing the distributing apparatus—consisting of feeder equalizers, ampere meters, pressure indicators, safety catches, and main conductors, and occupying the entire side of the room, 103 feet in length. The number of feeders at present is twenty-three, with arrangements for further increase. One noticeable feature in this station is that each feeder is supplied with two ampere meters, so that an intelligent idea of the general distribution of the load can always be arrived at, and any trouble more easily located.

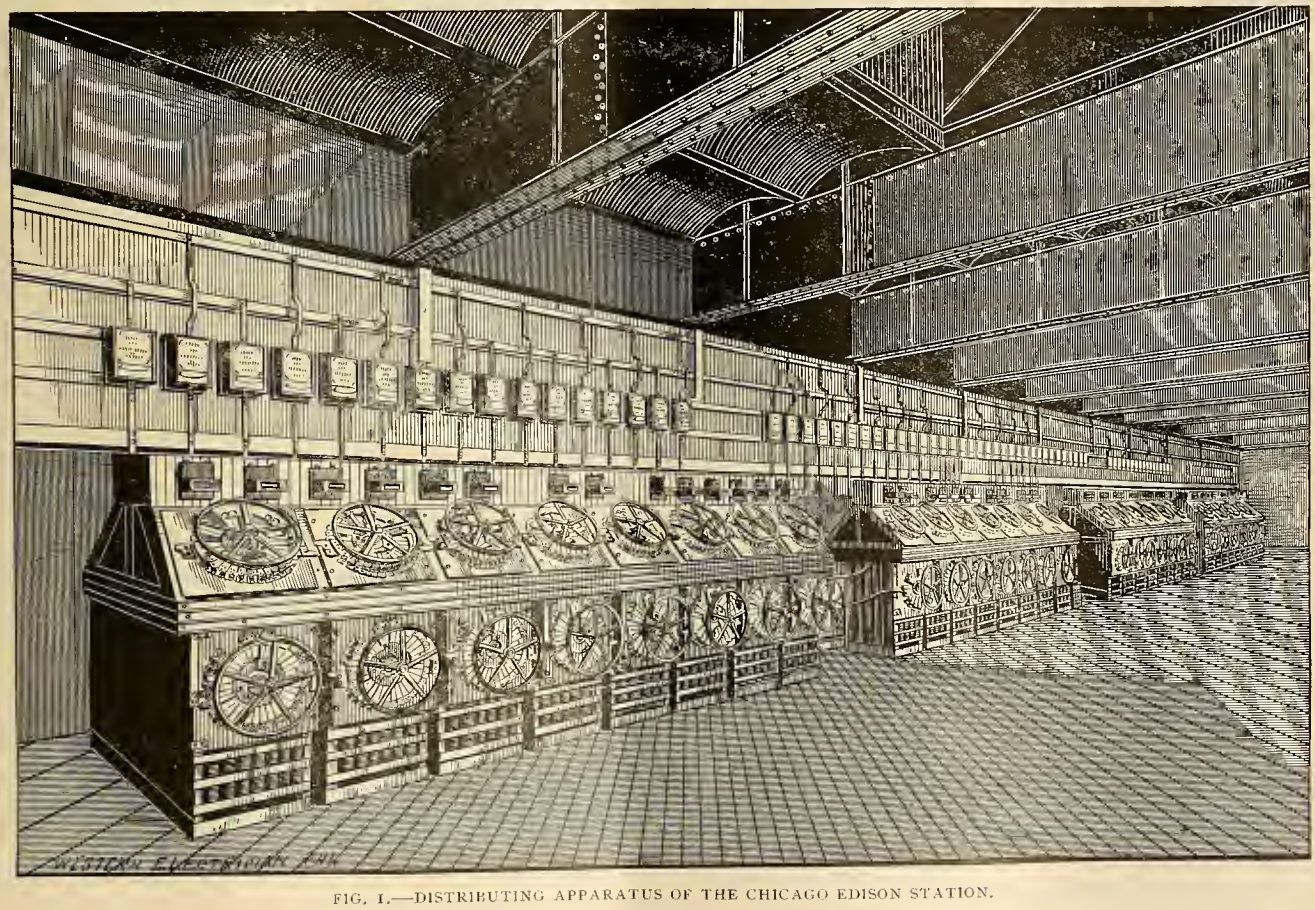

FIG. 1.—DISTRIBUTING APPARATUS OF THE CHICAGO EDISON STATION.

Fig. 2 is another view taken in the dynamo room, showing the regulating apparatus, namely, dynamo field regulators, two main amperes meter, each calibrated up to 1,500 amperes, eight individual dynamo ampere meters and switches for 750 amperes each, and standard pressure indicators, etc. Here the dynamos are put in and out of circuit, and their pressure is regulated.

The plan of the second floor is reproduced in

Fig. 3, showing a boiler room, dynamo room with general arrangement of machinery and apparatus, and meter room.

Fig. 4 is of interest in showing the general arrangement of the engines on the first floor.

The underground system of conductors consists of about 16 miles of electric tubing, laid in 20 ft. sections, each tube containing three insulated conductors. The total capacity of the system is 50,000 lamps, and the conductors are now carried in front of 120 block fronts. The tubing was manufactured and laid by the Edison Machine Works of Schenectady, N. Y. The work was begun last year by M. Waddell and finished this summer by W. S. Clark and John Wren, all of whom have been connected with the Edison Machine works for a long time, and have had good experience in this work.

The Chicago Edison company sell electricity to the public through a meter, so that each consumer pays only for what he actually uses. Experience in New York and other cities for many years past has demonstrated that these meters are very correct in their indications. The company are fully prepared to furnish electricity for power purposes as well as light, and the advantages of electric motors over all others for those who require power up to say 50 horse power, is now becoming so generally known and acknowledged that a large business in this direction may be confidently predicted.

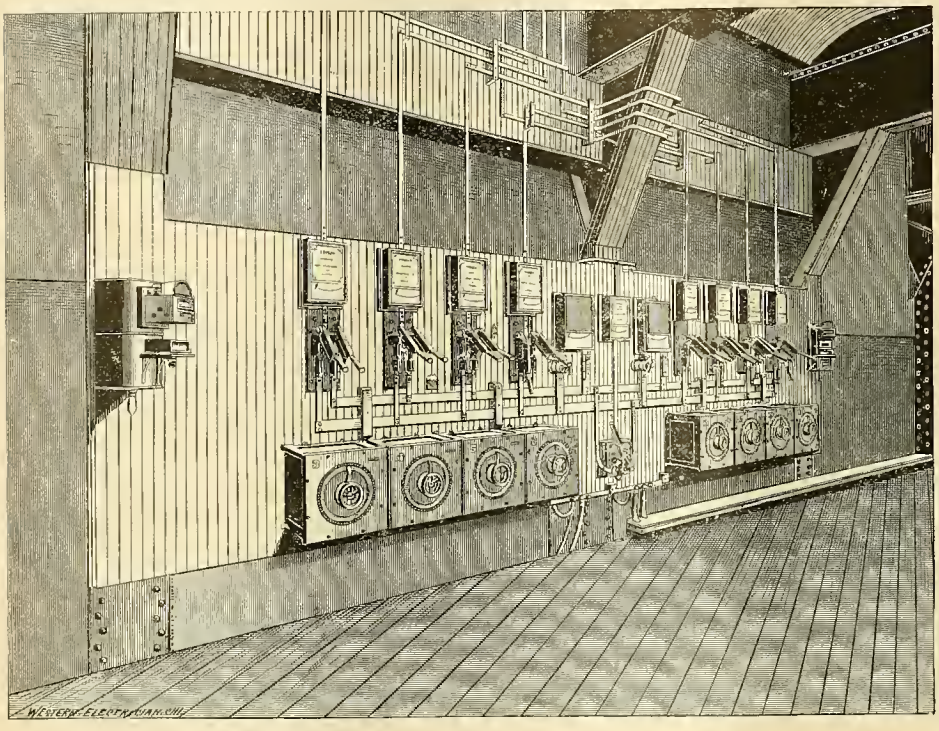

FIG. 2.—REGULATING APPARATUS OF THE CHICAGO EDISON STATION.

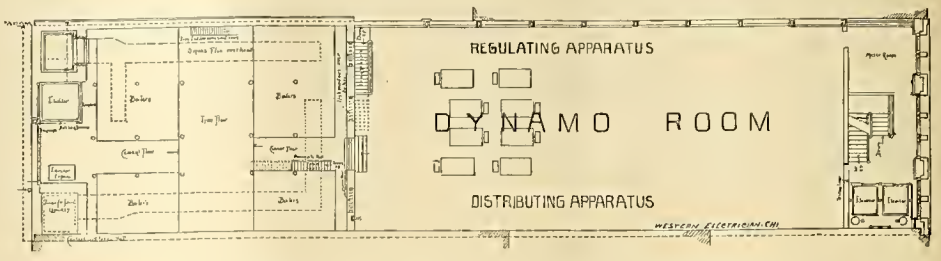

FIG. 3.—GROUND PLAN OF DYNAMO ROOM OF THE CHICAGO EDISON STATION.

Burning the Eyes.

"I can give you a recipe for the severest kind of torture," said an old time electrician as he adjusted a spring in a lamp he was testing. "Just burn your eyes in testing arc lights and you will suffer as you have never suffered before. You will feel as if some one had poured each eye full of acid and was rubbing it in. I know what this is I can tell you, as I have frequently burned my eyes. When I left the shop at night I could always tell if I had burned my eyes. There would be a halo about every light. The gas lights would have a band of light around them five feet wide, and the electric lights would seem to have great streamers running from them. When I saw these phenomena I knew that a night of torture was before me. It takes about five hours before the pain comes on and after the first night of it the worst is over.

"Have I tried to do anything to cure it?" asked the electrician, repeating a question which had been propounded to him. "What haven't I tried? I have experimented with almost every known remedy for the relief of pain. But it was to no purpose except it was a satisfaction to try and do something. I found one thing was helpful. When I saw the halos about the lights and knew the pain was coming on I used to get in the front seat of a cable car so the wind would blow in my eyes. Sometimes they would become so weak I couldn't hold the lids open.

"Although, as I have said, I have burned my eyes frequently in this way, I haven't found that it has affected my eyesight. My eyes are just as strong now apparently as they were when I was ten years old. I never wear glasses. I have learned, however, not to look at the arc as I used to. It is my impression that the smoke which comes from the carbons, especially when they are not burning properly, is one of the great causes of this burning of the eyes. The copper coating seems to give off a poisonous vapor which affects the sight."

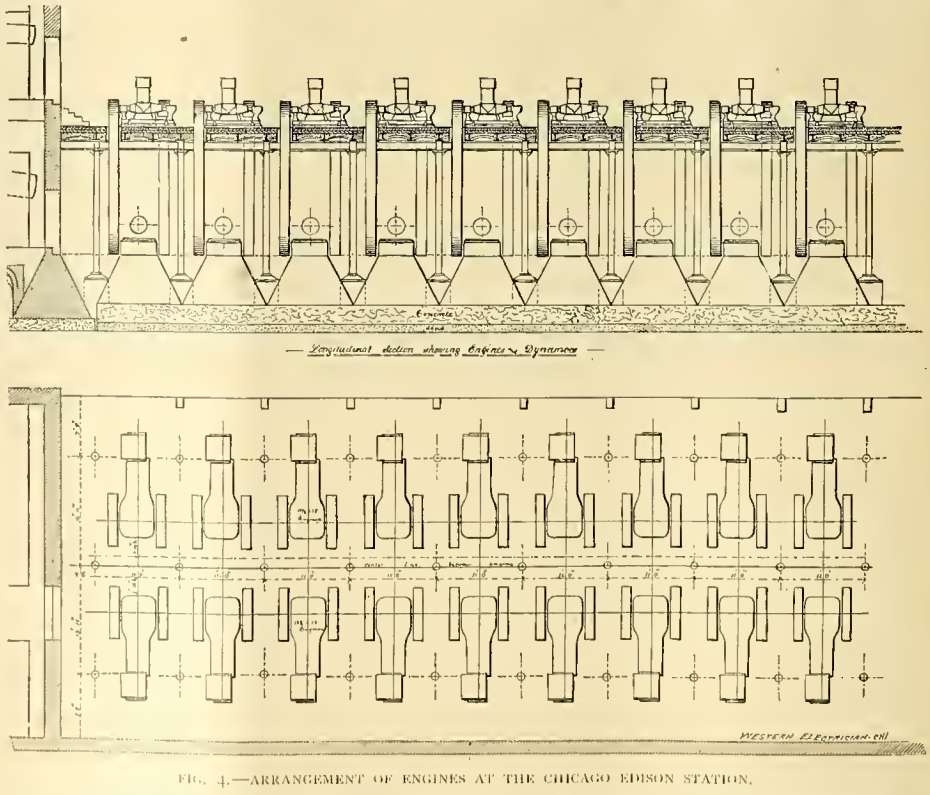

FIG. 4.—ARRANGEMENT OF ENGINES AT THE CHICAGO EDISON STATION.

The Lowth Stetho Telephone Company.

The Lowth Stetho Telephone Company of Chicago, has been incorporated. The capital stock is $5,000,000, and its incorporators are James Lowth, Edwin T. Brown, jr., and Allen C. Knapp. The instrument which the company proposes to introduce is based on a principle entirely different from that which controls the operation of the Bell telephone. The Stetho telephone is an invention of James Lowth, of Chicago. It does not depend upon air wave for operating and the diaphragm is dispensed with. The working of the instrument depends upon muscular contraction when it is used. The company is not yet ready to give a description of the instrument, as the patents have not all been secured. The object of the corporation is to engage in a general telephone business.

It is claimed by the inventor of the Lowth instrument that communication will be as perfect with his instrument as with the ordinary telephone, and that messages can be sent satisfactorily over as long a circuit.

Cushman Telephone Company.

"We are more hopeful about our case now than before it went into court," said Dr. Cushman, inventor of the Cushman telephone, a few days ago. "Why? Simply because of the errors which we are confident were made in the decision against us. That was a very strange decision of Judge Blodgett. We are confident of an ultimate reversal of the decision."

Shocks, Deadly and Otherwise.

"I don't know about executing criminals by electricity," said an electrician rather doubtfully. "I can only speak of the subject from my own impressions. I have never made any experiments but I have rather decided views which are the results of a good many years' practice. It has always been a belief of mine that it would take a mighty powerful current to kill me. Though it may not be so, I have thought that electricity often kills a man because he has a weak spot in him. I have taken all manner of shocks and they never did me any particular harm. In fact after it was over with, I felt better. The blood went circulating through me at a rapid rate and I felt as if I had life enough to accombe worse than hanging. I know perfectly well if I was compelled to take my choice I would plish almost anything. I took the entire current from a thirty light machine, and although I was thrown down in pretty lively style no harm resulted. How did it feel at the time? I have often described it thus: It seemed as if I had held out my hands and some one had struck them with a stuffed club with tremendous force. The most unpleasant shock I ever received was from a coil. It seemed as if a needle had stuck right into me.

"But to return to executions. Take a young, strong, healthy, vigorous man, and it seems to me that even a very heavy current might fail to do the work at once. It might simply torture him fearfully for a while until death finally came to his relief. That wouldn't do at all. It would take the rope. I would be afraid from what I have known of heavy currents that I might be simply tortured. It seems to me that the best way of sending the current through the body would be from the back of the head to the feet. I know it has been suggested that it would be better to send the current from wrist to wrist. I have taken most of the shocks I have received in that way and I am persuaded it is less dangerous than from head to foot.

"Talking about shocks, most of those who have been killed have been careless. It is surprising to see how careless men become. They don't keep their wits in their heads, but they take the most foolish risks."

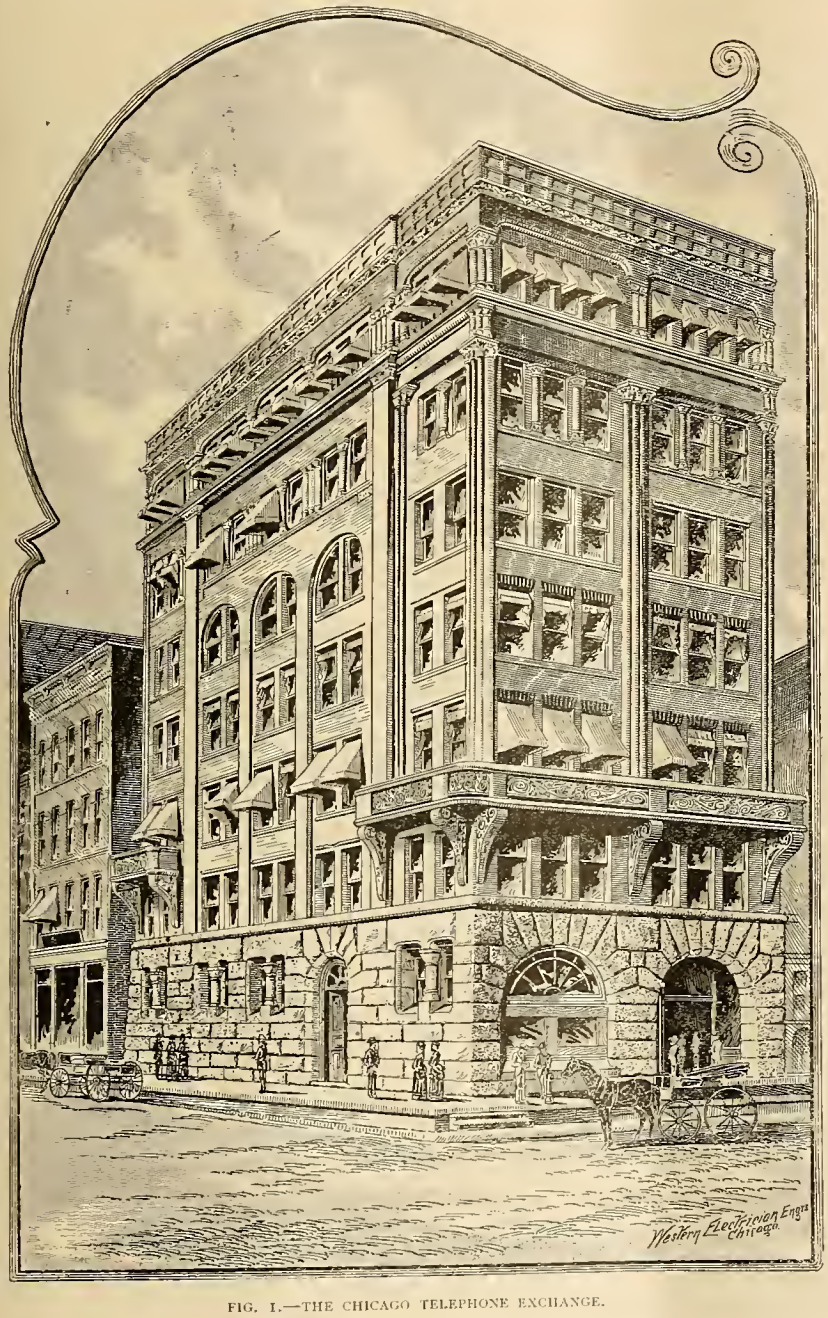

FIG. 1.—THE CHICAGO TELEPHONE EXCHANGE.

The Unprotected Watch.

"What makes you so solemn?" asked a gentleman of an officer of an electric light company as he entered the latter's office.

"Reason enough," was the reply. "Do you see that man going down the street? Well, he was in here a few minutes ago, looking at a dynamo. When he left he looked at his watch. It had stopped. It was magnetized. He went away in a huff and said he had no use for dynamos like ours."

The Eau Claire Brush Electric company, Eau Claire, Wis., recently ordered fifteen 2,000 candle power arc lamps from the Brush Electric company, Cleveland, Ohio. The Eau Claire company has made large additions to its station during the past year and is reported to be in a very flourishing condition.

The Chicago Telephone Building.

At the corner of Washington and Franklin streets, Chicago, stands the handsome structure known as the Chicago Telephone building. As an exponent of the greatness of the telephone business of the metropolis of the west and as well an exponent of the most advanced thought and skill of the electrician, the building is interesting alike to the lay and professional reader, and a full description, brilliantly illustrated, is warranted:

The building consists of seven stories, and nearly the whole of it is used by the Chicago Telephone company for its business, although one floor is given up to the main offices of the Central Union Telephone company and another is rented. The first story, as shown by the handsome cut of the exterior, Fig. 1, is built of roughly dressed Waupaca granite and those above of pressed brick, the facade being ornamented with terra cotta trimmings. The building is thoroughly fireproof throughout, and is provided with freight and passenger elevators, steam heat, electric lights and gas, and every other convenience known to modern art. The lower halls and the general offices of the company on the third floor are finished in cherry and in the rest of the building Georgia pine has been used. A hasty tour of the building will be of interest as showing the disposition of the various floors. The basement contains the engines and boilers and heavy articles of storage. The cables are brought into the basement from the conduits in the street, at the southwest corner. They are then led in a conduit laid under the floor, lined with boiler iron, to about the center of one side of the building, and there take an upward course. Inasmuch as the conduit is below the sewer in the street, a well has been constructed into which the conduit drains, a steam siphon elevates the water from the well and discharges it into the sewer. The conduit can, in this way be very easily kept free of water.

The first story or ground floor is devoted to the uses of the supply department and purchasing agent. The cables which pass upward through this story are so arranged in their supports that any one can be taken out without disturbing the others.

On the second floor are the offices of Superintendent Wilson and his assistant, Mr. Douglass; the repair department, an assembly room for inspectors and foremen's offices; an apartment devoted to the water motors which run the generators; a room that will be fitted up as a testing room and the cable terminals shown in Fig. 2.

President George L. Phillips, Secretary R. C. Wetmore, the cashier and the contracting agent, have offices on the third floor.

The Central Union Telephone company occupies the fourth floor; the fifth floor is rented as offices. The sixth floor is occupied in part as offices and in part as a toll room in which the main distributing board, shown in Fig. 3, is located. There is also on this floor a feature seldom found in the buildings of great corporations. This feature consists in handsome apartments, lunch and reading rooms for the lady operators. The rooms are light and airy, neatly furnished and very attractive. A matron is in charge at all times. The company furnishes tea, coffee, milk and sugar, for the operators or such of them as choose to, bring their lunches. The time allowed for lunch but not consumed can be spent in the reading room, which is cosily furnished, and like the lunch room very attractive. The policy of the company in throwing around the operators every possible safeguard, in providing quarters that are very convenient and pleasing, and in every way making the service attractive is a wise one, in that already it has resulted in bringing into their employ young ladies and girls of a high order of intelligence, and of the best character.

The seventh floor is the operating room, which contains the immense switch board, Fig. 4, and intermediate distributing board. At one side is the room for the local battery and its switchboard.

A review of the tour the reader has taken with the WESTERN ELECTRICIAN representative starts with the lead covered cables as they emerged from the conduits through the foundation walls of the building; their course in a conduit,

the top of which is flush with the level of the basement floor, and which is readily removed to the point where they take a turn upward to the rear of the second floor, where they end in the cable terminals, shown in Fig 2. At this point the lead covering of the cables is stripped, the wires branched to terminals and then bunched in office cables of 100 wires each, to continue their course upward to the sixth floor, where they connect to the main distributing board. In the underground system in Chicago there are very nearly 3,000 miles of wire. At the cable terminals there are seventeen 200-wire cables and two

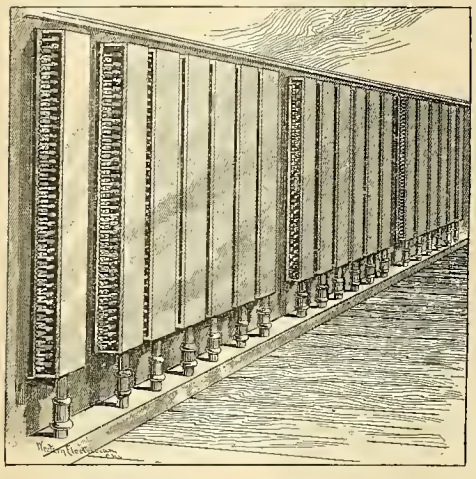

FIG. 2.—CABLE TERMINALS OF THE CHICAGO TELEPHONE EXCHANGE.

140-wire cables, which are at this point bunched as stated into office cables. The skill and neatness of the work about the cable terminals is worthy of especial mention. In a space not exceeding 10 feet in length, 5 feet in height and 6 inches in width, the measurements of the framework, including the wooden mouldings, all the connections have been made.

All of the office cable used is covered with asbestos fireproof covering. The insulation is largely silk, but where silk is not used and cotton takes its place, the cotton has been saturated with beeswax instead of paraffine. The cables are further protected with a sheathing of tinfoil to keep out the dampness. The wires are twisted together in pairs to provide for a metallic circuit system which, it is contemplated, will be substituted for the present system at some time in the future.

From the main distributing board still following the circuits, we trace the cables to the operating room on the seventh floor, and here, as shown at the right side of Fig. 5, we see the cables as they come through the floor, run through the trough and are connected to the switch board. Fig 5, it may be stated here, is a view taken from a photograph just before the wiring of the switch board was completed. The view is reproduced for another purpose, which will be explained later on; but reference is made to it here in order that the reader may have before him visual proof that he has traced the course of the cables from cellar to roof correctly.

The switch board, partially shown in Fig. 4, is a masterpiece of the electrician's art, and represents the latest improvements of the Western Electric company, who built it and in fact installed the whole plant under the supervision largely of Mr. Wilson and other executive officers of the Telephone company. Before an examination of the board, let the reader digest a few figures in order to properly appreciate the work. Between cellar floor and roof of the Chicago Telephone building, there are nearly 700 miles of wire, as several pages of memoranda, compiled by Superintendent Wilson and the WESTERN ELECTRICIAN representative attest; there is a total of at least 66,980 spring jacks, and when it comes to soldered connections in the building, the enormous total of 316,798 is shown.

But to investigate the switch board; nearly the whole floor extending north and south is given up to the board. The light is excellent, there being windows upon each end of the floor and the whole length of the side. The board is built parallel with one side and the end walls of the buildings, but the corners are not square, a section being placed diagonally at each corner. The construction is shown in Fig. 4 where the section at one corner is directly in the foreground and the perspective shows the length of the board parallel with the side of the building, with the top of the framework of the intermediate distributing board faintly outlined. There are now 18 sections of the switch board in place, while on the other side of the framework of the board, 12 sections more can be placed. the cables being between. The capacity of the switch board at present is 3,000 lines while the ultimate capacity will be 5,400 lines.

The intermediate distributing board which is an exact reproduction of the main distributing board, shown in Fig. 3, is something entirely novel in telephone exchange practice. First, this board is located about the middle of the switch board. Like the latter it is handsomely finished in mahogany and provided with colored and plate glass front artistically disposed. The board, is placed in circuits, intermediate between the connecting jacks of the main switch board and the drops. Its functions are to enable the manager of the office to assign any wire to any operator without changing the number of the wire. The circuit from the line first passes through the connecting jacks in the upper part of the switch board, the jacks being arranged in their consecutive numerical order, in the usual manner. The circuit then passes to the intermediate distributing board, and thence back to the answering jack and drop. The latter carries two numbers, one of which is the consecutive drop number, merely for the convenience of the operator, and the other is the subscriber's number. The latter is on an interchangeable plate which can be conveniently removed from its drop and placed on any other drop. This enables the manager of the office to distribute the work periodically between the operators in accordance with the needs of the service, so that instead of assigning an arbitrary number of lines to each operator, the lines which together will make a certain number of connections per day are assigned to each operator. At stated times a reassignment is made and thus the work is equalized. This feature has been found to be of great value in distributing the night work when the force is reduced. Subscribers, such as newspaper offices, express offices, and the like, who have frequent use for their telephones at night, are grouped in the same sections so that the bulk of the work is concentrated where a few operators can be placed to answer calls and make the night service in every way as good as the day service.

The wiring of the spring jacks in the switch board is novel and has been accomplished in the most workmanlike manner.

In Fig. 5, as shown, the cables at the right lead from the main distributing board to the spring jacks on the switch-board. After the wires are connected to the spring jacks in one section they are carried to the next, then the next, and so on around the whole board. The manner in which the cables are supported is shown in this cut. Iron rods are inserted in the frame work of the switch board. and upon them lie the cables in graceful curves as shown in the illustration. These rods are movable up or down, and in case it is necessary to get at a spring jack to repair it, the cables are lifted from the rods and then raised or depressed and the rods inserted in other holes in the framework. The spring jacks, instead of being fastened to the board with ordinary wood screws are held in place by a bolt and clamp of peculiar construction. Let the reader imagine a bolt of the form of the letter T. The horizontal line represents the clamp which is fixed immovably to the shank of the bolt. At the other end of the bolt, the screw thread is cut. On the face of the end a slot is cut for the insertion of the point of a screw-driver, and over it is a round nut which also has a slot in for a screw-driver. When a spring jack section is placed in its position in the switch board the bolt is thrust through the "stile" as it is termed, or a part of the framework, separating two adjoining spring jack sections, and then through the face of the section, with the clamp of the bolt horizontally. The nut is put on the front of the board, and with a double screw-driver the nut is screwed home one of the drivers, while the bolt is held in position with the other part of the screw-driver and prevented from moving.

The heads of the bolts are covered on the front side with a beaded strip, which carries the consecutive "100's," to which each section of spring jacks belongs. These numbers are gilt figures, embossed in black leather, counter-sunk in the beaded strip and covered with small square glass plates. This arrangement of numbers permits the boards to be cleaned at any time without rubbing the numbers off.

In a system where the details are so extensive it is difficult to include within the limits of an article of this character even brief reference to minor points that nevertheless have great interest and value to those engaged in telephone work; but there are several features of the exchange that are novel and add so much to the efficiency of the work, that perforce, they must be touched upon;

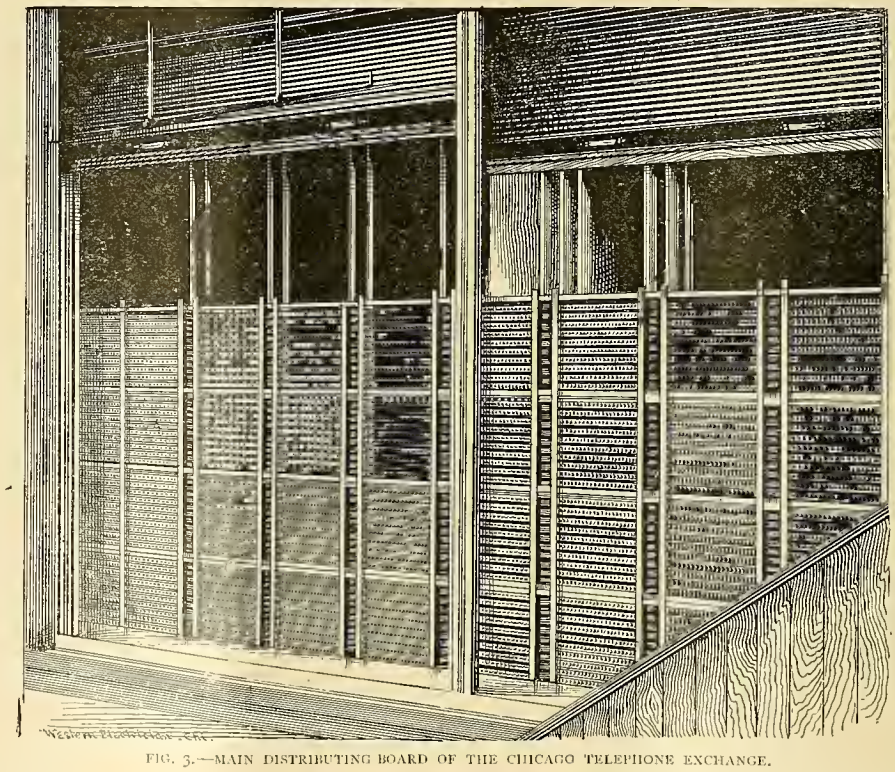

FIG. 3.—MAIN DISTRIBUTING BOARD OF THE CHICAGO TELEPHONE EXCHANGE.

The first is in the toll room on the toll switch board. For the benefit of non-resident readers it may be stated that the city of Chicago is surrounded by populous suburban towns and villages, and that the territory north, south and west for a hundred miles, is well inhabited. The amount of telephone communication between these adjacent cities, towns and villages and Chicago is large and is constantly increasing. Such communication is done through the toll board, the routine being in case of a city subscriber, calling a subscriber in Milwaukee, Wis., to call in the usual manner, giving the name of the subscriber and the name of the city. Such service is denominated toll service and is paid for at a fixed price per message.

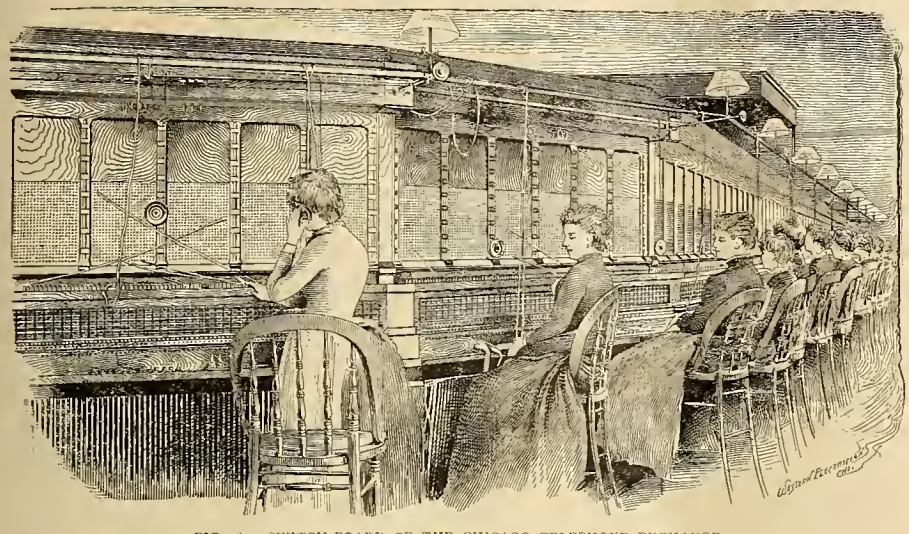

FIG. 4.—SWITCH BOARD OF THE CHICAGO TELEPHONE EXCHANGE.

But in many cases the calling subscriber is operating his own telephone and is not at a public telephone station where the charges for the message are to be paid or guaranteed in advance, and consequently unless the subscriber's contract calls for toll service and he has agreed to pay for such service, the message would be transmitted at the risk of loss. On the other hand, many subscribers want toll service contract and pay for it. The question always is: Is the subscriber entitled to toll service? In many exchanges records are kept, and in case of a call for toll service the operator consults the record, and is guided by it. The operators at the toll-board in the Chicago exchange settle the question in a manner so simple that it would be useless to mention it were it not for the fact that others have been very slow in finding the easiest way. Over each spring-jack representing a subscriber is a pin hole into which a pin is stuck if that subscriber is entitled to toll service; on the contrary the absence of the pin definitely settles the point that he is not entitled to such service.

In the room of the foreman of inspectors is another novel device known as the "trouble board." This board is designed to keep a monthly record of the work of each inspector. It consists of a wooden framework into which in vertical rows are placed movable blocks of wood, each bearing a telephone number. Each vertical row represents a district under the charge of a single inspector. Once a month he has to inspect every telephone in his district and report the results of his inspection to the office. In each wooden block there is a hole into which a brass pin is inserted. On the first day of each month the brass pins are withdrawn from all the blocks. Each inspector starts out in his district, inspects a number of telephones and reports to the office. When the report is made the pins representing the telephones inspected are placed in the holes and consequently the board shows the stage of inspection at all times. If trouble arises with any telephone that has not been inspected an iron pin is placed in the block bearing the number of the telephone complained of, and a disk or square of colored cardboard is hung on the pin, the shape or color, or both, indicating to the inspector at a glance wherein the fault exists. At the end of the month reports are made of each inspector's work. This board may be regarded as one of the most valuable adjuncts to the proper maintenance of the lines and instruments of the exchange.

The Davenport Electric Road.

An immense advance for Davenport was the verdict pronounced Sunday evening after the first electric car in Iowa had made several trips over the line, says the Davenport, Iowa, *Tribune*. Car No. 2 started Sunday at 3 o'clock A. M., and went over the road to East Davenport at a terrific speed, without a single hitch, with no stops at switches or corners, which were made with perfect ease. Sunday evening every one was watching for the car, which started at Second and Brady streets, at 9:40, went up Brady to 15th street, thence east to the end of the line, thence back to Brady and north to Central Park; then down Brady to the power station; in all a distance of five and three-fourths miles in thirty-three minutes. Not a single flaw was found either in trolley wire or ground wire. The route taken is made with horses in one hour and twenty minutes, and includes the long Brady street hill, 1,300 feet, with 7.30 per cent. grade; 300 feet on 13th street of 5 per cent. grade; and 300 feet north of Locust of 3 per cent. grade; eight switches to be made on the round trip, twelve curves, and three railroad crossings. The car lighted by five sixteen candle power Edison lights was certainly a remarkable and beautiful sight.

The cars were built by the La Clede company, St. Louis, and are made very strong, with 3-inch axles and heavy wheels, and weigh with the motor attached 3,600 pounds; they are 22 feet long over all and have the swinging gear so as to take the corners easily. They are beautifully finished. The motors are 7½ horse power each and are hung to each axle, and both are worked at the same time from either end of the car by means of a switch which the operator regulates with his left hand while managing the brake with his right. At either end of the car is an electric fare box which rings a bell as each fare is dropped into the box, and registers each as it drops below out of sight. The Central road was the first electric road to use these boxes. The trolley is so placed on the roof of the car as to allow plenty of motion to the trolley wheel, but keeping the latter pressed up against the under side of the overhead or trolley wire. The car receives its power from the trolley wires.

The current generated from the two car dynamos is of from 400 to 450 volts only, and is by no means dangerous. Mr. Sprague writes: "The pressure need not be more than 450 volts, and my men have frequently gotten shocked, both in practice and by way of a practical joke at from 400 to 600 volts, which is not comfortable, of course, but from which they have never suffered any inconvenience." The third dynamo gives a pressure of 220 volts only, which will be used to furnish power for motors for printing presses, elevators and machinery of most any kind.

The Book Table.

Advance sheets of the Directory of Electric Arc Lighting Plants in North America, compiled by the National Carbon company of Cleveland, O., for presentation to members of the National Electric Light association, have reached us. The information contained in the pamphlet is in readily accessible form. The states are given alphabetically, and the places in each state operating arc lights are arranged alphabetically under the head of the state. The names of the owners or operators of the plant and the system in use are given; the total number of lamps lighted and the number of commercial lights and street lights follow; and in case the plant is an isolated one, that fact is also noted. The directory, when issued, will be found valuable for reference by those who wish specific information regarding arc light plants in this country, in hand form.

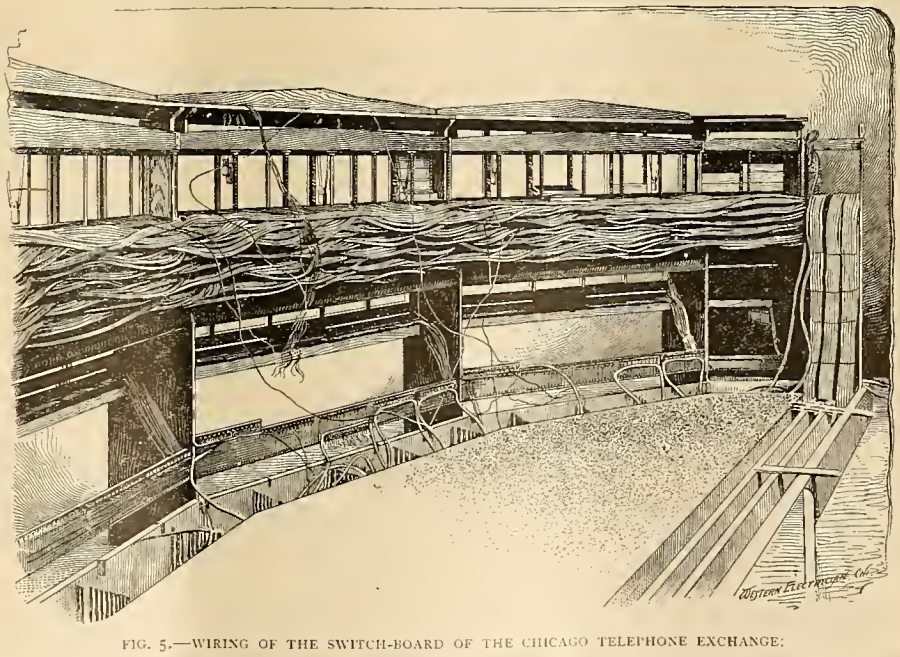

FIG. 5.—WIRING OF THE SWITCH-BOARD OF THE CHICAGO TELEPHONE EXCHANGE.

In a letter to Superintendent Hankinson, of the S. P. C. A. of New York, Harold P. Brown, the electrical expert, after denying that his experiments on dogs were prompted by mere "scientific curiosity," makes this proposal: "The dogs used were bought at the pound, and when there I saw the cage for drowning them, which, the attendant said, required ten to fifteen minutes to prove fatal. As the alternating current kills without pain in two to five seconds, I will supply the necessary wire, apparatus and connections for use at the pound in Harlem, provided you, through the city authorities, will make arrangements to obtain the alternating current at 400 to 1,000 volts pressure, from the electric lighting station on One Hundred and Twenty-second street, and will get permission to string the wires."

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

The Chicago Edison Station, Illustrated, ... 103, 104
Burning the Eyes 104
Lowth Stetho Telephone Company 104
Cushman Telephone Company 104
Shocks, Deadly and Otherwise 105
The Unprotected Watch 105
The Chicago Telephone Building, Illustrated 105, 106, 107
The Davenport Electric Road 107
The Book Table 107
Editorial 108
The Lifting Power of Magnets, by Prof. John E. Davies 109
Non-Magnetic Properties of Manganese Steel 109, 110
The McDonough Telephone 110
Chicago Exposition Electric Light Plant, Illustrated 110
Electrolytic Ammeters and Voltmeters 110
Annunciator Drops on a Derived Circuit 111
Electric Light Engine Diagrams, Illustrated 111
Lamp-Lighting Schedule – Moonlight System – September 111

DEPARTMENTS.

Correspondence 111, 112, 113
The Electric Light 113
The Electric Motor 113
The Telephone 113, 114
The Telegraph 112
Electrical Patents 114

The Place for the Next Convention.

We have information that it is the intention to urge Niagara Falls as the next meeting place of the National Electric Light association.

We wish to offer a word of suggestion in this connection. Counting the present meeting, six meetings of the association have been held east and *only two west.*

There is a feeling throughout the west that this matter of holding so large a proportion of the conventions east is being overdone, and if we are not mistaken it will make itself manifest in a smaller attendance than usual from the west at the present meeting in New York. Western members not only feel that it is asking too much of them to compel them to go clear to the Atlantic coast so often, but that the west is not being sufficiently honored in the matter of locating the places of meeting.

The matter of the location of the next meeting of the association is a serious one. No one wishes to see two electric light associations in the country, nor even a relaxation of interest by western members in the present association. Only one association is needed, only one is wanted, but an association which assumes to be national should not be allowed to become local, and this is what will result if the meetings continue to be held east in the proportion in which they have been held there heretofore. The next meeting and the one following it should be held west. If this is done western members will feel that they and the west are receiving due consideration, and it will be for the best good of all concerned.

Another thing. There is a feeling that the meetings of the association should be held annually instead of semi-annually. We understand that President Duncan has expressed this opinion also, and that this matter will receive consideration at the present meeting. We hope it will be brought up and that the association will decide to hold but one meeting a year hereafter.

Bring the association west next time, gentlemen, and have but one meeting a year, and your association will be more prosperous and useful than ever, and this is saying a good deal.

PROFESSOR DAVIES' communication on the lifting power of magnets and his conclusions are both interesting and valuable. As far as possible, the professor has avoided the use of difficult mathematical formulæ in order to bring the premises he lays down within the scope of the general reader.

A STATEMENT concerning the McDonough telephone is given in another column. Whatever the merits of the claim of the inventor may be, the article in question is interesting as defining the position of those who are interested in the alleged invention. All the opponents of the Bell company are confident of ultimate victory, and it will be noticed that Dr. Cushman in another column asserts that he is still hopeful in his struggle to maintain his claim of priority.

IN THE New York correspondence is pointed out the narrow escape of passengers of an electric car. The employe who had charge of the car deserted it just as it began to descend a heavy grade. Arguments against the electric system have appeared based on this incident, but the only possible lesson to be learned from it seems to be that railway companies should employ men who understand their business. The same lesson applies to all street car companies whether they employ the electric system or another mode of propulsion.

A NEW YORK gentleman who visited Chicago last week referred with a great deal of praise to the splendid appearance of Chicago's streets. "In a crowded thoroughfare in New York like Clark street," he said, "we have three lines of poles on each side of the street. One thing I don't like in Chicago, however, is the dirtiness which is caused by the clouds of smoke from soft coal." It may be interesting to this gentleman and to others to know that a vigorous crusade against the smoke nuisance is to be commenced in the city.

THE fall campaign in the electrical field will be unusually active if the news found in the correspondence and in the departments of the WESTERN ELECTRICIAN forms a basis for prediction. The outlook is bright, and electrical companies apparently have a busy season before them. The extension of the electric railways throughout the country is remarkable. The fact that street car managers, who are not the kind of men who enjoy risking their money, are putting such enormous sums into these lines furnishes perhaps the best argument in favor of the motors.

AFTER a perusal of the descriptions of the two notable installations—one the Chicago Edison central station plant, the other the Chicago telephone exchange plant—so handsomely illustrated in this issue, one cannot help marveling at the tremendous growth of the application of electricity to the uses of man within a few years. A short decade ago who but the far-seeing electrician would have imagined that for the purpose of providing quick telephonic communication for the residents of this city, between themselves or the residents of outlying cities, towns and villages, as colossal a plant as that shown would be required necessitating the investment of hundreds of thousands of dollars and the employment of the best skill that could be secured? Even less than ten years ago only the electrician could have pictured in a dream so remarkable a central station plant reproduced in miniature in the columns of the WESTERN ELECTRICIAN this week, representing, like the other, a very heavy investment of capital. When one plant is completed 5,400 telephones will stand ready to place those using them into instant communication with each other. When the other plant is completed 50,000 electric lamps will stand ready to shed their rays at the bidding of those who control them.

These plants stand as two splendid monuments to the electrician's art.

THE telegraph plays an important part in the social world, but not often is it called upon to perform such an important function as that which it executed at Alvaredo, Tex., on Aug. 19th. On that day the Missouri Pacific depot was the center of a hymeneal affair of decidedly romantic character. The Western Union wires were so manipulated as to unite in marriage William Newland of Trever, Cal., and Miss Dora Castion of Barnesville, Tex. A justice of the peace officiated at Alvaredo, and a clergyman assisted Mr. Newland. The report does not indicate that the bride needed any assistance. About this time Mrs. Newland will have joined her husband. Why the young couple preferred to resort to the wires to join them does not appear, but the knot is just as thoroughly tied as if the ceremony had been performed under ordinary circumstances.

"THE REPORT of the London Street Tramways company announces a dividend of 4 per cent. per annum, as against 8 per cent. at the corresponding period of last year. Forage has been dearer, and mortality among the horses has been in excess of the average, and there are also other reasons to account for this unsatisfactory state of the company's finances. The only way open to recover lost ground is to boldly go in for electric traction. Electro motors do not give up the ghost readily, coals will not vary in price like forage, which, after the terrible weather of the past few months, will certainly become still more costly, and Mr. Sprague's American experience clearly shows a vast saving over horse flesh by the employment of electricity. With the mileage now made on the Richmond line, £25 per day is saved in motive power expenses alone. It is hardly necessary, says the author, to point out that this means a good interest on a pretty large investment."

In these words the London *Electrician* commends Mr. Sprague's solution of municipal rapid transit to the attention of the directors of the London Street Tramways company.

DR. E. J. KAUFFMAN, one of the commissioners appointed by the New York legislature to recommend the most humane method of executing criminals, was in Chicago last week. To a reporter Dr. Kauffman stated that the commission in its investigation did not consider hanging for a moment, as the very barbarity of that method led to the appointment of the commission. Prussic acid was quick and almost painless, but was not always certain. The garrote and guillotine were also discarded as much more inhuman than hanging. "We then investigated electricity," he said, "and the farther we examined the subject the more we became impressed with its efficacy, and we finally adopted it." It is stated that Dr. Kauffman has invented a chair to facilitate the execution, and it is said he is confident that it will prove a solution of many of the objections which have been urged against this mode of inflicting capital sentences. He declares that he is not pushing the merits of his invention in a commercial way, and claims that he constructed the electric chair simply from his love of invention and as a result of the study of the various plans of execution now in vogue.

It is interesting to note in this connection that Kentucky is about ready to follow the example of New York and substitute electricity for the halter. This is at least the assumption of the Louisville correspondent of the WESTERN ELECTRICIAN.

The Lifting Power of Magnets.

By Prof John E. Davies.

Readers of the older books upon electricity and magnetism will remember a formula of Haecker's upon the lifting power of permanent magnets.

$$P = a \sqrt[3]{W^2}$$

where P being the lifting power and W the weight in German pounds, a was found experimentally to be a number from 8 to 10 for bar magnets, and 16 to 20 for horseshoe magnets, according to the quality of the steel and intensity of magnetization. This meant that a steel horseshoe magnet, weighing 1 pound for example, could lift between 16 and 20 pounds. We presume that to most readers, like ourselves, this formula had little interest save purely a theoretical one, and the fact that the lifting power was so relatively large for a small magnet. For example, according to this formula, a magnet whose weight was doubled would only have its lifting power increased about 1.6 times; if tripled, about 2.07 times; if quadrupled, about 2.5 times, and so on. Thus showing in a most marked manner the relatively rapid rise of magnetic power in proportion to weight with smaller magnets.

In a recent number of the *Philosophical Magazine*, Professor Sylvanus P. Thompson has shown that the empirical rule that lifting power is proportional to the cube root of the square of the magnet's weight was given by D. Bernoulli as long ago as 1758, and that Van der Willigen, "repeating the investigation partly with Haecker's own magnets and partly with more recent ones, found a somewhat different empirical rule, viz.:

$$P = bK \sqrt[4]{A} \sqrt[4]{\frac{L}{\sqrt{A}}} \times \frac{L}{l}$$

where b is a constant depending on the quality of the steel and its degree of magnetization, K the perimeter of the polar surface, A the area of polar surface, L the length between the actual poles, and l the mean between interior and exterior lengths of the bar."

The coefficient B was found by Van der Willigen to vary from 19.5 to 22.5 for good horseshoe magnets. This coefficient is virtually the same as Haecker's a.

Professor Thompson also shows that Haecker's or Bernoulli's formula is merely another way of saying that the lifting power of magnets in which the intensity of magnetic induction has been carried to an equal degree, is proportional to the polar surface, and that the coefficient a or b is proportional to the square of the magnetic induction through that surface. For making use of Maxwell's formula that the tension along the lines of magnetic force in any magnetic circuit is, in dynes per square centimeter, equal to the square of the induction divided by 8π the element of pull over an element of area dA, would be given by

$$dP = T.\,dA = \frac{1}{8\pi} B^2\,dA \quad (T \text{ being the pull in dynes per square centimeter})$$

whence, P (the total pull) $= \frac{1}{8\pi} \int B^2\,d\,A$

If the distribution of the induction be assumed uniform over the cross section [an assumption which is perfectly valid by taking for B a certain *average* distribution over the cross section in spite of the known concentration of B near the surface and at the edges of steel magnets of the usual form] the pull is given in dynes as

$$P = \frac{1}{8\pi} B^2 A$$

From this the average value of B the magnetic induction is easily found by a simple transposition of the formula. Thus:

$$B = 5{,}000 \sqrt{\frac{P \text{ kilos}}{A \text{ sq. cm.}}} \text{ or } 1{,}317 \sqrt{\frac{P \text{ lbs}}{A \text{ sq. in.}}}$$

according as we choose to use kilograms and centimeters, or lbs., and inches in our measurements.

So, also, if we imagine a cube of volume equal to that of the steel magnet under consideration, call d the mass in grammes of one cubic centimeter of it, l the number of centimeters in one edge we shall have for the value of Haecker's coefficient a:

$$a = \frac{1}{8\pi} \cdot B^2 \cdot \frac{A}{(l^3 . d)^{2/3}}$$

$$= \frac{1}{8\pi} \cdot B^2 \; d^{2/3} . \; c$$

if we represent by c the ratio of A (the polar surface of the magnet) to l^2, the face of the equal volume cube.

These results are exceedingly interesting as connecting the laws of permanent magnets with the ordinary theory of induction in electro-magnets, and the difference of the values of a for horseshoe magnets and straight bars, being according to Haecker double, while Van der Willigen found it to be from three to four times as great for horse shoes as straight bars, is a striking illustration of modern ideas concerning the resistance of the magnetic circuit, and shows that when such circuits contain air spaces the whole induction of the iron is dependent upon how much of air space must be traversed before the lines of induction can, so to speak, close their own circuit. In the case of long bars, magnetized by a short coil at the center, this resistance sometimes causes the greater number of magnetic lines to leave the bar not far from the center and pass around the magnetizing coil by way of a short path in air rather than go a longer distance in the iron and subsequently a longer distance in the air. There is doubtless magnetic leakage along a permanent steel magnet bar as well as along an electro-magnet, and this is greater in proportion as the magnet departs more and more from the closed ring form.

Non-magnetic Properties of Manganese Steel.

Some experiments which were carried out by Dr. John Hopkinson, F.R.S., and which formed ths subject of a paper read by him before the Royal Society on "magnetization of iron," caused a large amount of attention to be drawn to that peculiar form of steel known as manganese steel, says the London *Electrical Review*. Dr. Hopkinson found that in a substance with a substantial proportion of manganese, the latter "annihilates the magnetic property of iron," and that steel containing 12 per cent. of manganese is practically non-magnetic.

Naturally it occurs to one what bearing would this non-magnetic property of iron have in the manufacture of dynamos. Some information of a very valuable character as to the non-magnetic and electric properties of manganese steel has been contributed lately by R. A. Hadfield in a paper read by him before the Institution of Civil Engineers on "Some newly discovered properties of iron and manganese." It would appear that the non-magnetic properties of manganese were noticed as far back as 1774, when Rinman seems to have been the first to observe the curious fact that manganese deprives iron of its usual magnetic properties. He found that after melting equal parts of gray pig iron and manganese ore, the lump or button produced was, when fractured, of a white color, very brittle, and the magnet produced no action thereon. This peculiarity was also noticed in David Mushet's early experiments in 1830 on manganese. Mr. Hadfield remarks that this is especially curious, seeing that iron is present in amounts eight or nine times greater than the manganese itself. "An approximate idea of the amount of manganese contained in the steel may be formed by passing a magnet over specimens; as the percentage of manganese increases the magnet's power decreases. Upon reaching about 8 per cent. there is no attraction in the bulk, though fine drillings are influenced: but even this diminishes, as when 20 per cent. is reached a magnet capable of lifting 30 pounds of ordinary steel or iron will only lift pieces weighing a few milligrammes. On this point the material behaves in the same manner either in its forged or cast state; water, or oil-quenching, making practically no difference.

Since Mushet's experiments nothing appears to have been elicited of a definite character until 1885, when some facts were brought out by Dr. John Hopkinson, F. R. S., in some experiments carried out by him, which are given in the paper previously mentioned. Among the samples tested were some of manganese steel manufactured by Messrs. Hadfield, and of their behavior under the influence of magnetism we have the first definite records. Dr. Hopkinson says: "Another very striking feature is the way in which any substantial proportion of manganese annihilates the magnetic property of iron; the sample with 12 per cent. of manganese is practically non-magnetic. If all the substances in this sample other than the iron were mechanically mixed with the iron, and arranged in such wise as to have the greatest effect upon its magnetic property, no such annihilation of magnetic property would ensue." He states that "it is therefore clear that the small quantity of manganese present enters into that which must be regarded for magnetic purposes as the molecules of iron, and completely changes its properties. The fact is one which must have great significance in any theory as to what is the molecular nature of magnetization." The sample of iron with 12 per cent. of manganese and some small quantities of carbon and other substances is proved by these experiments to be slightly magnetic, that its magnetism would be accounted for by supposing that in its mass were distributed a few little bits of pure iron.

Some more specific details as to the non-magnetic character of manganese and its electrical properties will be found in a paper "On the physical properties of manganese steel," published in the "Scientific Proceedings of the Royal Dublin society," 1886, by Professor W. F. Barrett, of the Royal College of Science, Dublin. These details are from experiments carried out by Professor Barrett on a sample of Hadfield's manganese steel (C. .85 per cent., Mn. 13.75 per cent.) drawn into a wire of number 19 B. W. G. A very great deal of difficulty was experienced in the process of drawing the wire down owing to its hardness, but it was found that by heating the rods to a white heat and plunging them into cold water, they were easily drawn; but the same process had to be repeated after every reduction to two sizes. The remarkable tensile strength of this wire was determined by Professor Barrett at 110 tons per square inch. As regards the non-magnetic properties of this steel, Professor Barrett found that a small piece of the wire tested by him was not attracted in the slightest degree by the most powerful electro-magnet capable of lifting a ton, but suspended by a thread it behaved like a paramagnetic body pointing from pole to pole. In a sample which gave a faint trace of magnetism, Professor Barrett was enabled to make a determination to the extent that taking the magnetism of ordinary iron as 100,000, the manganese steel was 20. It was suggested by Mr. Hadfield that this peculiar non-magnetic quality of manganese steel might make it suitable for dynamo bed-plates.

A second point with regard to the electrical properties of this manganese steel, and one which must prove of great interest to electricians and especially to electric light engineers, is the remarkable results obtained as to conductivity. Professor Barrett found that its conductivity was very low, number 19 B. W. G. were .96 millimeter in diameter, having a resistance of 1.112 legal ohms per meter, or 75 microhms per cubic centimeter at 15° C. Ordinary iron wire being only 9,800 and German silver 21,170, he suggested that use might be made of manganese steel for resistance coils in electric lighting. This suggested use was successfully applied by Dr. E. Hopkinson at Messrs. Mather & Platt's, when some experiments were tried to demonstrate Dr. John Hopkinson's method of testing the efficiency of dynamos. A length of 1,180 yards of 8 B. W. G. (Mn. 13.95 per cent.) was cut into three lengths, coupled parallel, the conductor consisting of 3 strands number 8, then coiled into a box 3 feet by 2 feet by 2 feet, gave a resistance of 6.5 ohms, carrying 80 amperes without overheating. It was therefore capable of absorbing 55 horse power. Mr. Hadfield remarks on this that "to produce the same resistance with iron wire 5,000 to 8,000 yards would be required, or of expensive German silver wire 4,780 yards. The increase of temperature, when heated, Professor Barrett found to be only .136 per cent. for each degree C. as against iron .5 per cent. It will be seen therefore of what value this material may become when resistance coils are required for electric lighting purposes, as it appears to possess the necessary qualifications in a higher degree than any other metal.

The results as regards resistance have been

verified in some tests taken by Mr. Mordey, who remarked, in the discussion which followed the reading of the papers read by Mr. Hadfield, "It would be observed that the manganese steel, besides being non-magnetic, had a very high resistance; and as it had great strength, it would probably be used for purposes other than those contemplated in the paper. Electricians wanted a metal or an alloy that could take the place of German silver for light castings in the fittings of machines and apparatus where alternate currents were to be used. In alternate current dynamos, for instance, the small castings for the ends of the coils, and other portions which passed through the field or into the fringe of the field, were almost always of German silver." If Hadfield steel could be substituted, Mr. Mordey thought it would give just what was wanted, as castings for this purpose should have great strength combined with lightness; they should have a high specific resistance to prevent loss by eddy currents; and, generally, they were better if non-magnetic. In this direction we think that there is decidedly an opening for the employment of this material, but there are at present apparently some difficulties required to be overcome in consequence of the hardness of the steel.

With regard to this material and its combination, we find that Dr. Hopkinson considers that the manganese was not merely mixed mechanically with the iron, but that it did enter into the molecule in such a way as to destroy its magnetic properties. He remarks that "the magnetic property was really that which was most interesting, for it distinctly and clearly demonstrated that the material was not a mechanical mixture, but something in the nature of a chemical compound." There are many of our readers who are not aware of these peculiar properties of this alloy, and we have been induced to place these observations before them, in the hope that some among them may be enabled to carry out some further experiments, which may conduce to the further development of manganese steel and its possible successful adoption, for not only the purposes which we have mentioned but possibly for others also of still further utility to electrical engineering.

The McDonough Telephone.

The New York *World*, in its issue of Aug. 23rd, has given a somewhat detailed description of the McDonough telephone. The reporter who made the test of the instruments is described as a practical electrician. The instruments which were examined were made, it is asserted, in strict accordance with the patent specifications of April 10, 1876, by Prof. H C. Buck. Even license legally allowable was not taken advantage of. For example, it is stated that parchment diaphragms were used, although the specification permitted the use of other material. The test was made in the office of F. W. Jones, of the Postal Telegraph Cable company. The line was about 100 feet in length. It is reported that questions were asked and answered and in short, the receiver was put to as severe a test as could be conceived, and it unquestionably talked, not as well as the telephones in use, of course, but well enough to demonstrate absolutely that it was in reality a talking instrument.

The claim is made that the instrument makes a far better showing than the original Bell instrument. Mr. Jones, who is interested in the McDonough instruments asserts that the latter is beyond all question the inventor of the telephone. He alleges that the McDonough application defined that the instrument was intended for the transmission of articulate speech, while such a statement could not be made of the patent of Bell granted in March, 1876. Mr. Jones asserts that there is evidence to show that while McDonough was working on the instrument Bell discovered the fact, took his cue from it and hurriedly set about making a telephone to be placed in the Centennial. Mr. Jones was asked what McDonough's position was in the patent office at this time. He replied:

"At that time McDonough stood in the patent office as the first man in the world applying for a patent upon a method of transmitting and reporting articulate speech, and in his drawings accompanying his application a diaphragm receiver is shown, also an improved transmitter over that of Philip Reis. This invention of the diaphragm receiver is the key to the whole situation, and the only thing that has ever made a speaking telephone possible. Neither Bell nor all his legal advisers can controvert this statement, and if Commissioner of Patents Benton J. Hall is the man I take him to be, we will prove to the world that James McDonough is the inventor of the telephone. Bell people pooh-pooh all this by saying McDonough's invention wont talk, and if it does talk then they own it under a contract they made with McDonough. I believe they paid him $10,000 for some privilege, yet they are moving heaven and earth to induce Commissioner Hall to refuse us the chance to prove our assertion, the chance to demonstrate by a practical test in Hall's presence that McDonough's original instrument will talk; we ask nothing more."

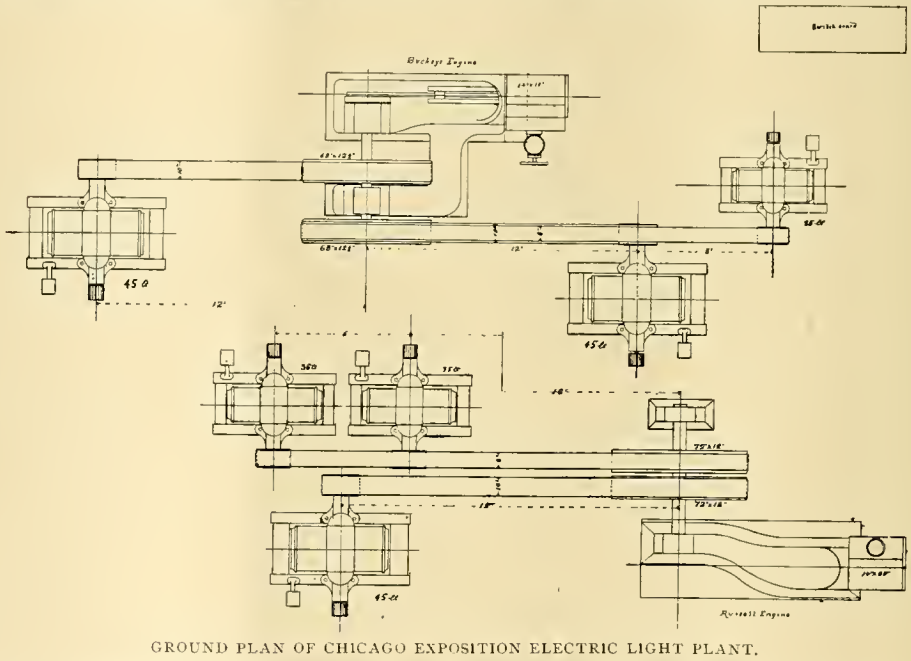
Mr. Jones alleged that thus far McDonough had been the victim of unjust treatment in the patent office. He continued:

"After three years' delay in the patent office, the application of McDonough went before Examiner Church on a trial of interference between it and Bell's alleged invention and those of Gray and many more inventors who had, subsequent to McDonough's application, made many improvements in some features of the telephone. The issue in this interference was 'a telephonic receiver, consisting of the combination in an electric circuit of a magnet and a diaphragm supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality.' Examiner Church, from the evidence, found as follows: 'Taking, therefore, April, 1876, as the date of McDonough's invention of the receiver in issue, it only remains to be considered whether Bell has proved prior conception, for he does not pretend to have constructed such a receiver prior to July, 1876. Upon the evidence submitted it is impossible to find that he had conceived, much less disclosed the invention in issue in this case. Upon this count, as defined and explained, J. W. McDonough is awarded priority of invention.' Here is an honest decision. An appeal was taken to the examiners-in-chief, who decided that, whereas, McDonough did not have, as they stated, a good transmitter he should not be confirmed in the priority of invention for any diaphragm receiver, and whereas Bell had a magnetic transmitter in perfect order, it entitled him to precedence as the sole inventor. From this decision McDonough took an appeal to Commissioner of Patents Butterworth, and on the very last day of that functionary's term of office his last official act was to confirm this decision, notwithstanding the fact that McDonough implored the privilege of going before the patent office and demonstrating that his apparatus would talk.

"All these years McDonough has been struggling along with limited means, poor health and such assistance as he could command to get his rights acknowledged in the patent office, and has been driven nearly crazy. He has also attempted in the courts of Connecticut, New York and New Jersey to secure a hearing of his case and a just decision upon its merits, but both his money and health gave out at a critical time and he could not press these suits. Mr. McDonough now asks the commissioner of patents to rehear the case and to allow him to show that the instruments as originally described will talk, and that he was not dreaming when he made his application for an articulating telephone on April 10, 1876."

Chicago Exposition Electric Light Plant.

The accompanying plan shows the arrangement of engines and dynamos of the electric light plant of the Inter State Industrial exposition at Chicago. There are to be two engines, one a Buckeye of 125 horse power, and the other of the same capacity manufactured by Russell & Co., of Massillon, Ohio. The two engines will drive three 45 light dynamos, two 35 light dynamos and one incandescent dynamo of a capacity of 250 sixteen candle power lamps. The dynamos are all of the manufacture of the Western Electric company of Chicago. One feature of the electric light exhibit will be two focusing lamps. One will throw colored light on the fountain in the center of the hall. The other will be placed in front of the building at the foot of Adams street.



GROUND PLAN OF CHICAGO EXPOSITION ELECTRIC LIGHT PLANT.

Electrolytic Ammeters and Voltmeters.

The old idea of measuring electric currents and potential differences by ascertaining the quantity of gas evolved in a voltmeter, which was worked out some years ago by Marcel Deprez, has recently been resuscitated by A. Minet, who has presented to the Societe d'Encouragement d'Industrie Nationale several instruments intended for the measurement of potential differences and electric currents, says *Industries*. He employs a voltmeter containing water acidulated with one two-hundredth part of sulphuric acid, as by an ingenious arrangement of electrodes and valves it is possible to collect either the mixture of oxygen and hydrogen, or each gas separately. The c. m. f. is computed by measuring the volume of gas evolved in a certain time, and by comparing these data with the corresponding data obtained with a standard Daniell cell. This cell contains no porous pot, the sulphate of zinc and sulphate of copper solutions being each contained in one limb of a U shaped tube.

The Columbia Electrical company of Portland, Oregon, has been incorporated with a capital of $25,000 by P. F. Morey, H. A. Hague, and James Laton.

Annunciator Drops on a Derived Circuit.

In the Chicago telephone exchange all the annunciator drops are being changed, so that instead of being in the main circuit, they are on what is technically called a "third leg," that is, the drop is on a derived circuit between the line and ground. Superintendent Wilson says: "Experience has developed the fact that with the Chicago underground system the loss of current by escape through a drop thus arranged does not weaken conversation anything like the placing of the same drop directly in the line circuit."

Electric Light Engine Diagrams.

The accompanying diagrams were recently taken from one of the Woodbury Engine company's automatic high speed engines, at the Edison central station, Rochester, N. Y. The engine is a 16x20 inch, running at 200 revolutions,

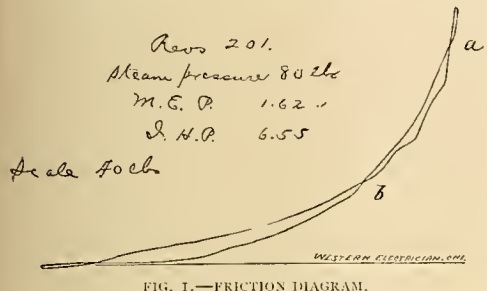


FIG. 1.—FRICTION DIAGRAM.

and the diagrams go to show excellent performance in economy and steam distribution. The diagrams are from the back or head end, the ones from the crank end showing no material difference.

A peculiarity of the friction diagram, which

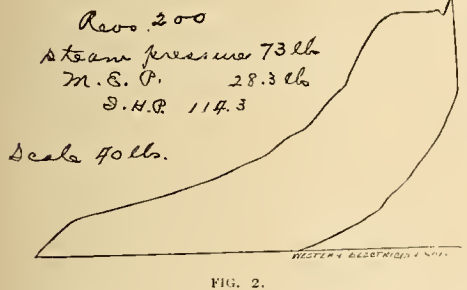


FIG. 2.

by the way, is a very light one, is that the expansion line crosses the compression line twice, at *a* and *b*. It also crosses the exhaust line near the end of the stroke, dropping below the pressure of the atmosphere until the return stroke. Even at this early point of cut-off, in which the

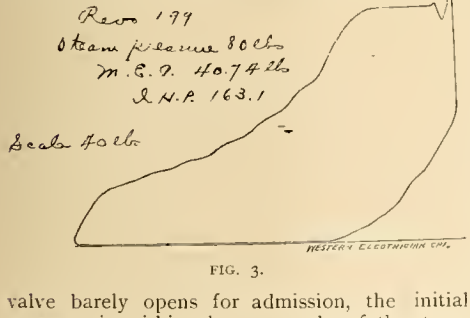


FIG. 3.

valve barely opens for admission, the initial pressure is within three pounds of the steam pressure, this being due to the four-point admission, as the valve presents four points of opening at the same time. The value of this feature is also shown in diagrams Figs. 2 and 3, in the excellent maintenance of the steam line up to the point of cut-off, and in the closeness of the initial pressure to the boiler pressure, the difference in each case being but two pounds. The exhaust lines will be pronounced perfect. This valve also furnishes double ports for exhaust opening and closure, a construction which secures the prompt drop of the line at release to the atmosphere, where it is maintained without back pressure, until the beginning of compression.

It will be noticed that the total variation in speed between the friction diagram Fig. 1 and Fig. 3, the latter representing the full commercial rating of the engine, is only 1 per cent. This close regulation is secured without sacrificing the stability of the governor, and must satisfy the most exacting requirements.

Lamp Lighting Schedule. — Moonlight System.

SEPTEMBER.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**7.00**	2.30	7.30
2	**7.00**	3.30	8.30
3	**7 00**	4.30	9.30
4	**7.00**	4.30	9.30
5	**7.00**	4.30	9.30
6	**6.50**	4.30	9.40
7	**6.50**	4.30	9.40
8	**7.10**	4.30	9.20
9	**7.40**	4.40	9.00
10	**8.20**	4.40	8.20
11	**9 00**	4.40	7.40
12	**9.50**	4.40	6.50
13	**10.40**	4.40	6.00
14	**11.40**	4.40	5.00
15	12.50	4.40	3.50
16	1.50	4.40	2.50
17	2.50	4.40	1.50
18	No	light.	0.00
19	No	light.	0.00
20	No	light.	0.00
21	**6.30**	**8.00**	1.30
22	**6.30**	**8.30**	2.00
23	**6.30**	**9.00**	2.30
24	**6. 0**	**9.30**	3.10
25	**6.20**	**10.00**	3.40
26	**6.20**	**10.40**	4.20
27	**6 20**	**11 30**	5.10
28	**6.20**	12.30	6.10
29	**6.20**	1.10	6.50
30	**6.10**	2.10	8.00
	Total number of hours,		167.50

The foregoing schedule is practically good for the United States.

The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

CORRESPONDENCE

New York Notes.

NEW YORK, August 23.—Like all new enterprises, the electric car is regarded by many with fear and distrust, and it has arrived at just that stage when a trifle may turn the current of public opinion against it. The popular alarm which was recently created by the statement that a woman on the Jamaica railway was struck and paralyzed by electricity, has no sooner been allayed by the fact being established that lightning and lager beer were about equally responsible for the occurrence, than another accident is reported on the St. Clair electric road, where an electric car fairly ran away. It dashed down a mountain side at terrific speed, and came to a stop at a turn in the road. Fortunately no one was injured, but had the accident happened at any other time in the day than it did the result might have been serious. F. Whiteside Rae, the electrician of the Daft Electric Light company, shows in a letter to the *Evening Sun*, of the 17th inst., that "the man, and not the motor, was at fault." He says, "The car did not become unmanageable, but an incompetent driver with mechanical and electrical brake, as well as reversing power at his command, deserted his motor in a panic just as it was entering upon the maximum gradient, and a curve of fifty feet radius. 'Any horse," he adds, "will run away if the driver leaps from the wagon," and he cites the fact of the safe rounding at such high speed of the sharp curves of the mountain roadway as proof of the wonderful strength and stability of the machine.

The Board of Electrical Control has followed up its recent action by a letter to the board of aldermen and commissioner of public works. This letter was in line with the recommendation of a coroner's jury that an ordinance should be passed to secure more effectual insulation, and better construction of electric light plants. It seems that 122 complaints have been made to the department of public works, and nothing has been done to remove the obstructions complained of. To the United States Illuminating company, the "red rag" of the board, are attributed 528 violations of the law, and attention is called to the danger of delaying in proceeding criminally against corporations which violate the rules and regulations provided, and the advantage to be gained by summary action on the aldermen's part. Attorney General Tabor has denied Commissioner Gibbens' application to allow him to bring special action against the United States Illuminating company for failing to comply with the provisions of Chapter 716, laws of New York, relating to electrical conductors. The attorney general holds that the law provides a remedy.

There was recently to have been an important meeting of the Board of Electrical Control to discuss a general plan by means of which the different electric light companies might be induced to place their wires on one set of poles. The commissioners were ready to proceed, but there was such a small representation of companies that it was deemed advisable to let the whole matter rest for a week.

Laws may be made to increase the safety of electrical conductors, but they will never supersede the necessity for something like ordinary care on the part of those who are exposed to the possibility of contact with the wires. A case is reported from the new Croton aqueduct, where Nelson Richardson, a colored laborer, was instantly killed by touching an electric lamp. Along the roof of the tunnel, where he was working, wires were strung, and the lamps were suspended at intervals of fifteen or twenty feet, reaching to within a few feet of the floor of the tunnel. Richardson was in a stooping position, filling a pail with mortar, immediately beneath one of the hanging lamps, when he raised himself, and the back of his neck came in contact with the lamp, and he was instantly killed. The current held him against the lamp for a few moments, and one of the bricklayers who hastened to his assistance and attempted to drag him away, received a severe shock. One fact is remarked, which in view of the recent discussion of the question of executing criminals by electricity is of considerable interest, namely, that the only disfigurement on the body was a discoloration on the back of the neck at the point of contact with the lamp.

The National Electric Light association, which holds its convention in this city on the 29th, 30th and 31st inst., gives promise of more than its usual interest and importance. Dr. Schuyler S. Wheeler will treat of "Electric conductors in New York;" F. B. Crocker of the "Ideal motor;" C. C. Haskins of "Practical pointers;" W. L. Church of "Electrical steam engineering;" E. C. Acheson of "Effects of disruptive discharge in underground conductors," and further papers will be read by O. B. Shallenberger, Dr. L. Duncan, E. L. Nichols, Dr. Leonard Waldo, and others.

A very interesting paper appears in *Nature*, contributed by Captain John Ericson on his perfected sun motor. The distinguishing feature of his device is the adoption of flat surfaces and parellel rays for purposes of reflection instead of curved surfaces and converging rays. He states that a surface of reflecting mirrors of 100 square feet presented at right angles to the sun at noon in the latitude of New York, during the summer, develops a mechanical energy reaching 1,850,000 foot pounds per hour, and asserts that the sun power will be steady and constant.

An extraordinary circular is now exercising the minds of electricians. It bears the name and address of Shippey Brothers, limited, of London, England, and it states that at a convention of patent experts recently held in Washington, D. C., appointed by the trade in order to discuss certain claims in relation to incandescent lamp manufacture, the firm was awarded "an absolute monopoly for the supply of fancy lamps, and for all lamps of 100 candle power and upward for incandescent lighting." Who is this body of patent experts, and if it exists, whence comes its authority? The question "Who is the White Pasha?" is still enveloped in mystery, but we are inclined to think that we shall know all about that, and many other problems which now remain unsolved, before Messrs. Shippey Brothers of London, England, will be able to give us a satisfactory *raison d'etre* of their remarkable circular. G.

From Ottawa, Ill.

OTTAWA, Ill., August 23.—The Thomas Electric Light & Power company, which operates the Thomson-Houston system, is so crowded with orders that a new thirty-five light machine has been ordered. The induction which has bothered the telephone people, has been removed by the abandonment of the Western Union company's circuit over the route. It is quite a relief to the patrons of the telephone line.

The Electric Street Railroad company expect to begin work about October 1st, and to have two miles of the road in operation by December 1st.

The residences of George Roberts and Lorenzo Lealand are being wired for electric bells and incandescent lights. The work is being done by Lewis Degan of this city, who has just taken the contract to wire Mayor Ames' new residence in Streator.

The Ottawa Window Glass company is changing and extending its lighting plant in the different factories to corre-

spond with changes made in the buildings during the summer. The company operates the United States system.

It is reported that an incandescent system will be installed here shortly. Such a plant would certainly be a paying investment. E.

From Louisville, Ky.

LOUISVILLE, Ky., August 22,—Louisville's first electric railway is now nearly completed. The construction on Green street is progressing rapidly. The overhead system of transmission will be employed. Under each car will be a 15 horse power motor. Thus, in case of necessity, each car so supplied will be able to draw after it several ordinary cars. The system has been fully tested in Richmond, Virginia, where some forty cars are in operation.

This road will have a length of about four miles. It is expected to extend the system in time in both directions from its present route. The road will be in operation in about two months. The time made will be more than twice as fast as that of the ordinary horse cars.

In addition to the Green street line another electric railway is projected here. It is proposed to run a line of cars between this city and New Albany, which is on the Indiana side of the Ohio. This city is about five miles from Louisville. The projectors are, however, not likely to do anything until the Green street line has been completed and proved a success.

Electricity may shortly be given a new use in this city and state, although it is not a new use in some other states. At the next meeting of the legislature a bill will be presented providing for judicial executions by means of electricity. A number of the most prominent men throughout the state are in favor of it, and the bill is likely to be passed. "I have carefully studied the workings of the New York law," said a city official to your correspondent yesterday, "and I am satisfied that electri ity is the best agent of destruction to be used in judicial executions. I have made a study of electricity, and it will accomplish its work with neatness and dispatch."

Louisville, although a southern city, is not behind in electrical matters, even if she does have a number of o'd fogies in her council. The latest scheme talked of is to have the public illumination done by electricity instead of gas. Although the population of this city is only 200,000 the city spreads over a large territory. This greatly increases the cost of lighting the streets, and the city's yearly bill for this purpose is no small item of municipal expense. It is claimed that after the plant is put in the electric lights will be cheaper, and the illumination will, of course, be far superior to that of gas. It is understood that the agents of several of the electric light companies aae going to push the matter before the city council. This will cause a bitter fight. The Louisville Gas company is a powerful corporation with several million dollars of capital, and it will, of course, oppose the use of electricity, as it derives no small revenue from the public lights. Still the friends of electricity are strong and numerous, and they are going to do all they can to secure the change.

W H. Johnson, inspector of electric lights, has been busy for some time, making his rounds and examining the wires. In the main he found everything all right, but at some places he found good evidence that the city should have had an inspector long before one was ever thought of. At several places he found wires not insulated through the neglect of their owners, and only good fortune has prevented accidents. He had these faults remedied, and is now engaged in his task of hunting for more.

The electric light is just making its first appearance in the Kentucky mountains. Lately, eastern Kentucky, which is wild and mountainous, consisting of a great wilderness of forests and mountains, never penetrated by railroads, has attracted great attention from Eastern and foreign capitalists on account of the immense richness of its mineral deposits. An English company with several million dollars capital has invested in the heart of this region, near Cumberland Gap. It is building there a handsome town, with all the modern appliances, not the least among which is the electric light. The streets will be lighted with it, and it will also be put in the houses. Some of the lights are already in use there. They are the admiration and astonishment of the natives who had never seen anything of the kind until they were put in about a month ago. These people had never seen gas lights either, and even the use of the lamp was unfamiliar to them, a tallow dip being their ordinary mode of illumination. So one can imagine the curiosity with which they regard the electric light.

It is probable that the *Courier-Journal* will attempt the use of electricity in running the type-setting machine, with which its composing rooms is fitted. Thirty of these are in use in that office, and steam is now their motive power. It is thought that electricity will prove much more effective power, and besides being cheaper, will reduce the danger of accidents.

Shelbyville, Cynthiana, Danville, Harrodsburg and several of the smaller cities of the state are likely to soon have the electric light.

The grand electric illumination during Louisville's fall celebration is now an assured fact. A large sum of money has been appropriated for that purpose. A committee appointed to supervise the illumination has gone energetically to work and will make the affair a complete success in all particulars. Every kind of electric light will be used, and the sight will be worth seeing. A.

From Kansas City, Mo.

KANSAS CITY, Mo., August 23.—The Edison Electric Light company has started on the erection of the new building and incandescent light plant at what will be the corner of the new Wall street north of Seventh street and in the rear of 115 West Sixth street. Three years ago E. R. Weeks, manager of the Kansas City Electric Light company, with a number of prominent business associates, started the plan of building a new and powerful station at the place named as an adjunct to the station of the Electric Light company at Eighth and Santa Fe streets. The Kansis City Electric Light company purchased the lot, but it was found difficult to raise the money for a plant sufficient, in the minds of the projectors, to supply the needs of the city. From $400,000 to $500,000 was required to put the station, as originally planned, in operation. The failure of a number of electric light companies in the east during the past three years caused the investment to be looked upon by cautious capitalists as not one of the best. At the same time the city authorities, backed by public sentiment, began to agitate the matter of requiring telegraph and electric light companies to place their wires underground, and this tended to make capital still more timid. Afterward a franchise was granted the Edison Electric Light company, and the company leased the lot on Wall street and has now begun the erection of a building. The new station will be supplied with twelve 200 horse power engines, and will have a capacity for furnishing 30,000 incandescent lights. Incandescent lights and power only will be supplied from this station. The building will cost $30,000, and will be fitted up with $75,000 worth of machinery. The plans show a building 54x96 feet, with very heavy walls, fireproof, iron girders and partitions, that can ultimately be run up to a height of ten or eleven stories. Only the basement and first story will be erected at this time. The new station is expected to be ready for occupancy in November. Mr. Weeks says the wires near the station and on the main thoroughfares will be placed underground.

Alderman Finlay of this city, was in New York recently and spent considerable time inspecting the conduit system for electrical conductors used in that city. He returns a most enthusiastic believer in the system, and says it possesses all the advantages, and few, if any, of the disadvantages of any other. Mr. Finlay went down in the manholes and examined the ducts and cables and made a thorough investigation of the methods of construction and operation. Mr. Finlay says he is now going to do as much as he can toward securing a conduit system for this city.

Superintendent Weeks of the Kansas City Electric Light company, in discussing the underground system, said he considered all the systems still experimental at least as far as concerned arc light wires. If the city wanted an experiment he was perfectly willing to place a half mile or mile of arc light wires underground, but in his opinion there was no insulation like dry air.

Work upon the central station of the Inter-state Electric Light company is still proceeding very slowly, owing to the delay in finishing the building in which it is located. Machinery and materials are arriving for it, however. Among the arrivals last week were an Ideal engine and a Fort Wayne Jenney dynamo. A.

Nebraska Notes.

OMAHA, Neb., August 23.—Superintendent Kerts of the Union Pacific telegraph, and Superintendent Dickey of the Western Union, have just returned from a trip to Eastern Pennsylvania, where they made a thorough investigation of railway induction telegraph system as in operation on two divisions of the Lehigh Valley road. They were greatly pleased with the system and are anxious to have it tested on a division of the Union Pacific, which will be done soon. President Adams is desirous of introducing the system on the whole line of the Union Pacific, but is deterred by reason of the great expense. It is believed that the fast trains, officers, trains and the most important stations will be equipped for the operation of the system in spite of its cost.

FAIRBURY, Neb., August 23.—The telephone exchange will be ready for business in a few days. It is exceedingly well equipped and promises to be a success from the start. Steps are being taken here by the local capitalists and business men looking toward the organization of an electric light company. F.

From Erie, Pa.

ERIE, Pa., August 23.—The city authorities have granted the Erie Passenger Street Railway company the privilege of erecting wires and poles for the purpose of enabling electricity to be used as a motive power in running their cars. Work will be begun at an early day, or just as soon as the company can decide upon the system it will use. The officials of the company have been absent from the city for several days investigating the various railway motor systems in use in other cities.

The question of the right of city authorities to compel corporations occupying streets to grant privileges to opposition corporations, is one that has never been definitely settled, by reason of the diversified character of the ordinances by which the privileges were originally granted. The seemingly loose manner in which ordinances are drawn, is likely to produce an immense amount of litigation in the near future. Only the other day ten workmen, engaged in erecting poles on State street, for the Edison Electric Light & Power company, were ordered by the mayor to desist. Refusing to obey his order, they were all arrested and taken before an alderman, and each man fined $5. The electric light company paid the fines and appealed the case. In the mean time the work of putting up poles has stopped. The ground of the arrest was that the company was not complying with the city ordinances in relation to the erection of poles in the streets.

The Western Electric company has recently turned over to the city of Dunkirk, N. Y., the arc electric light plant recently erected in that city under contract with the city authorities. There are about fifty arc lights.

The Climax Electric Light company of Corry, Pa., has erected in that city an arc and incandescent light system, and is gradually increasing the number of its subscribers. Several of the dynamos manufactured by the Climax company are in use in private plants in this city.

The Bell Telephone company of Buffalo is erecting a new wire on its poles from that city to Dunkirk, which, when completed and connected with the system of the New York and Pennsylvania Telephone and Telegraph company, will make telephonic communication easy between Erie and Buffalo and towns south from Dunkirk. The telephone lines between this city and Dunkirk, and from there to where they connect with the Buffalo lines, have been recently reconstructed. F.

From Little Rock, Ark.

LITTLE ROCK, Ark., Aug. 22.—The Edison Incandescent Light company is now advertising that it is ready to wire the places of those who want their light. The company has ordered a plant twice the size of the one first contemplated, and expects to start October 1st with about 2,000 lights.

The Little Rock Electric Light company, which is controlled by the Gas company, also advertises that it will furnish incandescent lights to its patrons, having contracted with the Westinghouse company for a plant, to be in operation next month. The company now operates a Brush arc system, and has one of the finest and most complete stations in the southwest.

The Fort Wayne Jenney company has just closed a contract with the city of Dallas, Tex., for the sale to them of an arc electric light plant like the one now being erected here. The Dallas plant comprises 200 arc lamps of 2,000 candle power, for which the city pays $72,000. The plant is to be in operation by October 1st. Some two hundred of the same lot of poles gotten out for this city's plant, and left over, have been forwarded to Dallas. The plant here is nearly finished. The poles are set and the wires run, the towers are all up, and linemen are at work cutting in the lamp circuits. The lamps are suspended from a mast arm over the center of the streets at the corners, the arm being balanced by weights, so as to lower the lamps for trimming. It is expected that the plant will be in operation next week.

Two exceptionally severe thunderstorms came down on this city, ordinarily free from such visitants, the evenings of the 17th and 18th. Both were accompanied by heavy rain. The one on Friday played the mischief with the telephone wires, breaking down and crossing them in many places. It also crossed several wires with the electric light wires. The result was that one or two drops in the exchange were burned out and the electric light circuits were grounded so that they had to shut down. Saturday night the lightning was worse than on the night previous. It struck four poles, making kindling wood of them, the pieces being scattered for over a hundred feet in every direction, burned out several bells and telephones, and had a merry time generally. In one place, where an unused Pan-Electric telephone had been left, it set fire to the house but did no damage, the fire being quickly put out. A.

News from Missouri Cities.

KIRKSVILLE, Mo., August 23.—This city is to be lighted with electricity. Electric lights of 2,000 candle power each are to be furnished for $10 a month.

REID SPRINGS, Mo., August 23.—The Reid Spring Hotel company has awarded the contract for a 200 incandescent electric light plant to the Hawkeye company of Oskaloosa, Ia., through its Kansas City representative. One hundred and twenty-five lights will be used at first.

ST. JOSEPH, Mo., August 23.—During an electric storm last week, over three hundred telephones were burned out.

C.

The Buckeye State.

CINCINNATI, O., August 23.—The board of public affairs has granted the Consolidated Street Railway company permission to open sidewalks along Colerain avenue to place therein suitable posts for constructing an electric railway.

COSHOCTON, O., August 23.—The Coshocton Gas company has sent an order to the Indianapolis Jenney company for a $12,000 electric light plant.

LIMA, O., August 22.—Frank McGraw, operator of a motor on the electric street railway, was fatally injured last week. The travelers which conduct the electric current from the wires to the motor, came off, and as McGraw was in the act of readjusting them he caught hold of both wires, forming a complete circuit. He was knocked from the top of the car, a distance of about ten feet, and seriously injured. He was rendered insensible, and it was with the greatest difficulty that he was resuscitated. His hands were badly burned and he received internal injuries.

G.

Two Kansas Towns.

ARKANSAS CITY, Kan., Aug. 23.—The Arkansas City Electric Light company will greatly increase its arc and incandescent plants. The contract for the additions has been granted to the Thomson-Houston company.

KANSAS CITY, Kan., Aug. 23.—It is now settled that an electric railway will be constructed here. The franchise has been duly granted by the council and signed by the mayor, and just as soon as it has been properly published the contractors will begin the work of construction. The contract has been let to the Thomson-Houston company.

D.

The Far West.

LOS ANGELES, Cal., August 23.—The Los Angeles Electric Light company is increasing it capacity and greatly enlarging and improving its plants. Two immense Hazelton Tripod boilers arebeing put in and are attracting a great deal of attention. Besides boilers, the company is putting in three immense driving wheels, each of sixteen feet diameter, driven by large and finely constructed engines. The increased power will equal 500 horse power. The improvements will cost $30,000.

G.

From Council Bluffs.

COUNCIL BLUFFS, Ia., August 23.—Work is progressing fairly on the new electric motor line. All the "sleepers" are laid and the irons will be placed in position at once. Messrs. Wickams, the contractors, have a large force of men engaged on the motor company's new power house on First avenue and Twenty ninth street.

E.

From Sparta, Ill.

SPARTA, Ill., Aug. 23.—James E. Gaston, inventor of a new electric headlight for locomotives, refuses to dispose of his patent or the light to manufacture. He proposes that the factory shall be built here at his home, and asks the citizens to grant a bonus of land sufficient for his purpose and the necessary gas for fuel.

B.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	340	345
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	44	47
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	110	112
Bell of Mo.	150	155
Iowa Union	27	28
Missouri and Kansas	70	71

A dispatch of August 21st from Wheeling, W Va., says: "Water, gas, and natural gas mains, sewers, telegraph and telephone wires, electric light and street car power conductors were carried down by the storm."

THE ELECTRIC LIGHT.

The Western Electric company of Chicago will soon have its high tension outfits completed.

The contract for installing the electric light plant at Ellensburg, W. T., has been let to D. Thierry of Seattle.

The Thomson-Houston company of Chicago has sold the Fargo Incandescent Light company a 500 light plant.

The Coshocton Electric Light & Gas company of Coshocton, O., has been incorporated, with a capital stock of $10,000.

Electric light wires set fire to the cupola of the Grand Union hotel at Saratoga Aug. 21st. About $2,000 damages was caused.

The Western Electric company of Chicago has received an order for a 45 arc light plant as an addition to the plant at Coldwater, Mich.

The Kansas City Electric Light company has ordered of the Thomson-Houston company of Chicago a fifty light arc plant as an increase to the present plant.

The Duluth, South Shore & Atlantic Railroad company, Marquette, Mich., has recently increased its arc light plant by ordering a number of arc lights from the Brush company, Cleveland, O.

The committee on lights of the Joliet, Ill., city council, after an investigation of different systems, have contracted for forty-five arc lights of the Waterhouse system to light the streets of that city.

The Pike Electric company of St. Louis has ordered of the Excelsior company of Chicago a complete steamboat arc plant, making the seventy-fifth plant of the kind ordered of the company for the Mississippi.

The Brush Electric Light company of Rochester, N.Y., has recently ordered a large number of arc lamps from the Brush Electric company of Cleveland, Ohio. This company is now burning 1,150 arc lights and 1,000 incandescent lights.

The Excelsior 100 arc light plant of the Mercantile Library Association at St. Louis has been started. Messrs. Scruggs, Vanderwort & Barney, the lessees of the building, assert that it is the finest plant that they have ever seen.

The Excelsior Electric company of St. Louis has ordered of the Excelsior company of Chicago two thirty light dynamos for an increase in the central station plant which is now working to its full capacity, night and day. The Ide engines will be employed.

A joint meeting of the stockholders of the Lynn Gas Light company and the Lynn Electric Light & Power company of Lynn, Mass., was held at the gas company's offices on Aug. 2d, and a unanimous vote was given in favor of consolidating the twin interests.

The Eau Claire, Wis., Electric Light & Power company, which has a central station plant of 90 Excelsior arc lights, has decided to install a 650 light Westinghouse alternating plant. The gas company which has employed the Brush system will install a Ft. Jenney incandescent plant.

Banker Moritz Mayer of Vienna, has his town house lighted with electric light, for which purpose he has a set of 30 accumulators. In the summer he takes these out and fits them into an electric launch, by means of which he careers about the beautiful waters of the Worthersee.

The sixty light arc plant which the Van Depoele company will send to Natchez, Miss., was tested last week. The lamps are provided with the positive automatic cut-out and their action is well nigh perfect. In the tests the dynamo supplied 70 arc lights at a speed of 700 revolutions.

The officers of the Excelsior Electric light company are well satisfied with the recent decision of Judge Colt in favor of the Thomson-Houston company. The company acknowledged the validity of the patent two years ago and secured a license to use it and the improvements made upon it.

Profs. King and Davies of the State University at Madison, Wis., have reported in favor of installing an Excelsior plant of 15 arc lights in the college building. The report was adopted. The automatic regulation was the feature which commended itself particularly to the professors.

New Orleans suffered considerable from storms last Saturday, Sunday and Monday. The city was in darkness on Sunday, the electric light plant being shut down on account of the contact of the electric light wires with telephone and telegraph wires. Telegraph wires were down in all directions.

The Chicago City Railway company have ordered through F. W. Horne, western manager of the Excelsior Electric company, a 25 light dynamo for the 63d street station. This makes 117 arc lights that are now in use of the Excelsior company's system in the various power stations of the cable railway.

C. C. Sutherland, general agent of the Brush Electric company for the western part of New York state, has recently sold to Alfred Costello & Co., for their tannery at Costello, Pa., an incandescent electric light plant complete, consisting of a 200 incandescent dynamo with the full complement of lamps

The Charlestown Gas company, Charlestown, Mass., has recently increased its electric light plant by the purchase of a number of double arc lamps from the Brush Electric company, Cleveland, Ohio. The company now has in use several Brush dynamos 30 light capacity each, and several hundred 2,000 candle power Brush arc lamps.

At a recent meeting of the Allegheny sub-committee on gas to consider the lighting of Allegheny City by electricity they approved specifications for forty-five electric light towers, with three to six lights on each; eighty-five poles for single lights, and 1,500 incandescent lights to be used in the City Hall, engine houses, etc., and so reported to the general committee. It was thought a better rate would be obtained by letting the contract for lighting for five years, and the question of the right of the committee to let the contract for that term, was referred to the city solicitor.

The Binghamton Gas & Electric company, of Binghamton, New York, is increasing its electric light plant. It has ordered from the Brush Electric company of Cleveland, Ohio, one 65 arc light, 2,000 candle power dynamo and arc lamps. This company is now burning about 266 arc and 300 or 400 incandescent lights of the Brush system.

The Glenwood Electric Light company, Glenwood Springs, Col., recently increased its electric light plant by purchasing a Brush dynamo, 65 light capacity, 2,000 candle power, with a full complement of 2,000 candle power arc lamps. This company is now operating 125 arc lights and several hundred incandescent lights of the Brush system.

The Brush Electric Light company of Buffalo, N. Y., is increasing its electric light plant. It has recently ordered from the Brush Electric company of Cleveland, Ohio, two 65 light 2,000 candle power dynamos with lamps. This company is now burning, including the lights just ordered, 1,300 arc lamps and a large number of incandescent lights.

Supt. John Richardson, of the bureau of encumbrances of New York, in the department of public works, has begun the work of removing the "dead" poles from the streets. He has a gang of ten men at work with derricks, axes and trucks. As fast as taken down the poles are carted off to the corporation yard. Thirty poles have been removed from William street and vicinity. The work will be continued until all the "dead" poles are removed.

Incandescent lamps suffer considerably on shipboard from the constant vibration; and especially on warships, where the shocks produced by firing the heavy guns now in vogue are particularly destructive to filaments. Woodhouse & Rawson of London have just brought out a new type of their unflashed lamp for this particular purpose. The filament is very short and broader than that usually used. The natural resistance, also, of the filament is higher than that of the lamps made with flashed filaments.

THE ELECTRIC MOTOR.

The 100 horse power plant which the Van Depoele company of Chicago has installed at Rockford, Ill., will be started at once.

The Thomson-Houston Electric company, Rees & Henderson of Baltimore, and William Wharton, jr., of Philadelphia, will make electrical exhibits at the American street Railway convention in Washington, D. C., October 17th.

The South Side Street Railway company of Cleveland, O., proposes to operate that branch of its road which extends from Central market across the central viaduct and through Jenney Ave., by electricity. Ordinances are now before the city council for the franchises and right of way.

General Jack S. Casement of Painesville, is a busy man, says a Cleveland paper, as in addition to constructing the waterworks tunnel, he is largely interested in electric street railways. Some time ago he went down to Erie, Pa., and purchased the controlling interest in the dilapidated horse car line of that city. In a few weeks the cars will be propelled by electricity. Not contented with this he decided to give the citizens of Akron better service. His efforts were successful, and an electric railway is now in the course of construction there. The rails are being laid on East Market street, the Euclid avenue of Akron, and many of the old citizens who have never been disturbed by "the rattle of the car over the stony street," object to the innovation. More than a dozen injunctions have been issued, but the work of laying the track is progressing. East Market street leads to the Sixth ward of Akron, which is the manufacturing center of the prosperous city, and the electric railway will prove of great value to the working men and employers. Both the Erie and Akron roads will be completed in a short time.

THE TELEPHONE.

The Western Electric Company of Chicago has just shipped multiple switch boards to St. Joseph, Mo,, and Topeka, Kansas.

The Western Electric company has received an order for 10,000 feet of cable from the Missouri & Kansas Telephone company of Kansas City.

The Chicago Telephone company is laying a submarine cable across the Calumet River at Ninety-fifth street, the intention being to supply East South Chicago with a telephone service.

A new cable has been ordered by the Sunset Telephone-Telegraph company, which will be laid between Oakland and San Francisco. The cable will cost $30,000 in all. As there has been found so much trouble from induction on the land portion of the circuit to San Francisco, the wires on the mole will be so arranged that they will not be affected by the telegraph or electric light currents of high tension.

At a recent meeting of the Mining Association and Institute of Cornwall, T. Scott Anderson, district manager of the West of England & South Wales Telephone company, read an interesting paper entitled "The Telephone: Its application and development," in the course of which he mentioned that he had held a conversation, and that distinctly, through coils of wire representing 180,000 miles, although, of course, such a feat was not practicable along a wire running on poles. The great utility of the telephone in mining operations had been amply demonstrated in Cornwall and in the collieries of the north. Not long since a poor fellow was crushed underground in a mine near Camborne. Thanks to the telephone, the accident was known at the surface in five minutes, and the injured man, who if aid had been long delayed would probably have died, was brought up in the "skip." Nothing could be imagined of more

paramount importance than a ready means of communication in mines. Each working level of a mine could be placed in direct communication with the surface and every other level for about £5 a year; thus if three underground workings were required to be joined to the surface, the cost per annum would be about £20. The room in which the lecture was delivered was placed in communication with the 388 fathom level at Dolcoath.

Sir Edward Watkin of London, it is said, intends offering a prize of one hundred guineas for the best solution of the problem of telephoning on trains between passenger and driver, or between passenger and guard. He has been trying for some years to do this, and believes it to be the true solution of the problem of proper communication. "Of course," Sir Edward is reported as saying, "there are many difficulties—vibration and so on; but in my judgment there is nothing that cannot be overcome. If it could be done, that would be a revolution. When an old woman feels she can talk to the guard and her conversation will be registered by the telephone company—we should have to carry telephone boys on the engine or in the van—she feels it a comfort; she is no longer, as she fancies, between a certain person and the deep sea. At present, of course, it would not do to stop a train because a man thinks the carriage is shaky when it is perhaps only his nerves. With a telephone he could talk away, and properly explain whatever he wished. That is one of my pet projects, and another is the electric locomotive."

THE TELEGRAPH.

Telegraph poles are preserved in Norway by making an auger hole about two feet from the ground, in which four or five ounces of sulphate of copper in coarse crystals are placed and plugged in. The chemical is gradually absorbed by the wood until its whole outer surface turns a greenish hue. The sulphate requires an occasional renewal, and is said to be a perfect preservative.

Telegraph poles are about as unsightly as anything that now straddles across our country, says the St. Louis *Globe-Democrat*. They are getting to be so numerous that some device should be thought of to conceal or cover them. If nothing better can be done let them be painted green But it is quite possible to grow vines on them of sorts that will make them ornamental, but will not reach the wires. At the present rate of increase these poles will never be out of sight in any well-settled part of the land. In Brazil nature is said to have taken the matter in hand, and is covering not only the poles but the wires. Thousands of little mistletoes took root in the air after lodging on the wires, and although soon dying they give better lodgment to other seeds, and so a green fringe is created along the line. It does not interfere with transmission at all. However, we can get along with naked wires if the poles are put to ornamental use.

Personal Paragraphs.

Charles A. Sweetland, editor of the *Electro-Mechanic*, was in Chicago last week.

C. W. Robinson, manager of the Royal Electric company of Peoria, Ill., was in Chicago last week.

S. A. Barton, manager of the Thomson-Houston company, Chicago, returned from his Eastern trip last Thursday.

G. A. Schaefer, formerly with the Fort Wayne Jenney Electric Light company, is now electrician of the Royal Electric company of Peoria, Ill.

Col. Gouraud, who represents the Phonograph company in London, has been invited to read a paper on the instrument at the meeting of the British association.

C. F. Warner, manager of the Rockford Electric Power company of Rockford, Ill., spent a day in Chicago last week, and was a guest at the Chicago Electric club.

Business Mention.

The Western Electric company of Chicago has received large orders for Patterson cables from Buffalo, Boston and New York.

The Western Electric company of Chicago is finding it hard work to keep up with its orders for Disque-Leclanche batteries and insulated wires.

The Western Electric company of Chicago has a force of men working nights on magneto bells. The company will soon manufacture 500 bells per week.

The Brush Electric company, Cleveland, Ohio, report that their carbon business is larger than ever before. They have shipped within the last month or two eight solid carloads of carbons to different portions of the country.

The Curtis Regulator company of 59 Beverly street, Boston, Mass., manufacture a diversified line of steam and water specialties, such as steam pressure regulators, steam traps, expansion tubes, water pressure and pump pressure regulators, and damper regulators.

L. E. Ingalls, president of the Joliet Electric Light company, at Joliet, Ill., says that his company consider that they have now the finest light extant, and are so well pleased with the Westinghouse system that they have concluded to increase their plant forty more arc lights.

The Ozokerite Mining company of New York has been incorporated with $1,250,000 capital stock. The officers are: President, Jacob Wallace; vice president, James Chaskel; secretary and treasurer, Charles H. Barkley, and general superintendent, Richard J. Kroupa. The object of the company is to mine deposits of ozokerite in Utah Territory. This mineral wax is used by several electrical companies as insulation.

The New Haven Clock Company, of 315–321 Wabash avenue, Chicago, have secured the western agency for the well-known Alfred F. Moore insulated wire. The firm of Joseph Moore & Sons, of which Alfred F. Moore & Co. are the successors, enjoys the reputation of being the oldest electric wire concern in the country, having been established, we believe, in 1820. The New Haven Clock company will push the sale of these wires vigorously in the west.

The Elgin Telephone and Electrical Supply company of Elgin, Ill., is out with a new catalogue. Several pages are devoted to the Elgin telephone, the invention of William Hubbard. This acoustic telephone, it may be said, is not excelled by any in the market. Telegraph instruments are shown and then follow illustrations of push buttons of various styles, bells of different kinds, burglar alarms, annunciators, batteries, and telephone supplies, and in fact a general line of electrical goods.

Frank S. Marr of Pittsburg, Pa., whose name is associated with some of the best equipped Edison stations in America, notably at Reading, Pa., New Orleans, La., Columbus, O., Grand Rapids, Mich., Chester, Pa., Westchester, Pa., Wilkesbarre, Pa., Scranton, Pa., Altoona, Pa, Atlantic City, N. J., and St. Paul, Minn., can point with justifiable pride at his latest achievement, the installation of the Chicago Edison station, for which he held the contract. Careful and thorough workmanship is shown at every point.

Electrical Patents.

Issued August 21, 1888.

388,008. Electric Signaling. Clement Ader, Paris, France.

The 9th claim is given: "9. The combination, with an electric signaling circuit divided into two branches, two telephonic receivers, one in each branch, a rheotome adapted to direct the current into said branches alternately with a frequency corresponding to the rapidity of vibration of an audible note, and two local batteries intercalated in said branches with their poles reversed relatively to the line."

388,023. Railway Signal. Thomas P. Curry, Danville, Ky.

488,052. Multiple Switch-Board. Milo G. Kellogg, Hyde Park, Ill.

The first claim follows: "1. In a telephone exchange system, a metallic circuit-line, a switch for said line containing two contact pieces to which the two sides or branches of the line are respectively connected, and a loop plug, with the two conductors of its double conducting cord connected to its two contact pieces, respectively, said plug being adapted to be inserted into said switch, and when inserted to connect its two contact pieces with the two contact pieces of the switch, in combination with a test receiving instrument connected on one side to one of the conductors of said double cord and on the other side to a switch testing device adapted to be brought into connection with a contact-piece of the line, and a battery in the circuit between the switch testing device and the contact piece of the plug connected therewith."

388,053. Arc Lamp. Virgil C. Killin, Chicago, Ill.

The claim is reproduced: "In an arc lamp, a carbon feeding device consisting of a rack upon the carbon rod, a pinion meshing therewith, a shaft carrying such pinion, a ratchet wheel on the shaft, a friction pulley loose on such shaft, but secured thereto by a dog which engages the ratchet wheel, said shaft with pinion pulley and ratchet wheel journaled upon a lever armature which is pivoted at one side of the carbon rod and at one end suspended over the electro-magnet core and at the other influenced by a counter spring, a friction chain about such pulley, fixedly held at one end and at the other secured to a pivoted arm which is downwardly drawn by a spiral spring, and a stop which engages such arm when the armature has descended a certain distance, the engagement of said arm loosening the chain on said pulley, and thus permitting the carbon rod to descend until the current passing through the carbons weakens the current through the electro-magnet and permits the armature to rise until the chain again grasps the pulley."

388,078. Machine for Tempering Metal Wires and Strips. Frederick Sedgwick, Chicago, Ill.

The first claim is given: "1. The combination; with a machine for tempering metal wires and strips, of a feed mechanism consisting of a feed pulley upon which the wire is first trained, with means, as a shaft and pulley, for driving the same at a uniform rate of speed, and a receiving spool journaled upon a frictional bearing upon a shaft or spindle adjusted to rotate at a higher rate of speed than that of the feed pulley, whereby the spool may be revolved at a greater or less speed in proportion as the coil is wound thereon"

388,091. Harmonic Telegraphy. Francis Van Ryssel-berghe, Brussels, Belgium.

The first claim is given: "1. In a tone or harmonic telegraph, the combination, with a tuning fork operated by the main line currents, of an extension on said fork, a local circuit controlled by the extension, and a telephone in said local circuit."

388,092. Telegraph Receiver. Francois Van Ryssel-berghe, Brussels, Belgium.

Third claim reads as follows: "3. In a tone or harmonic telegraph, a receiving instrument, consisting of a bent magnetized frame, a series of forks secured to and constituting one pole of the frame, and a core piece secured to and constituting the other pole of the frame and controlling all the forks."

388,093. Dynamo Electric Machine. Montgomery Waddell, New York, N. Y.

The eleventh claim runs: "11. The combination of field magnet, two armatures connected in series between the poles of said magnet, two main conductors extended from opposite terminals of the series, a compensating conductor extending from the conductor joining the armatures, a central magnet between the armatures, a shunt between the two main conductors, resistance coils in said shunt, a conductor ex ending from at or near the point of connection of the compensating conductor, including coils of said central magnet, and terminating in an arm adjustable along said resistance coils, and coils on said central magnet included in said compensating conductor."

388,140. Electrical Type Writer. James F. McLaughlin, Philadelphia, Pa.

388,141. Electrical Type Writer. James F. McLaughlin, Philadelphia, Pa.

388,142. Electrical Type Writer. James F. McLaughlin Philadelphia, Pa.

388,143. Electrical Type Writer. James F. McLaughlin, Philadalphia, Pa.

388,152. Non-Magnetic Alloy. Alfred H. Roberts, Ponts Martel, Switzerland.

The first and second claims are given: "1. A metallic alloy composed of tin, copper, lead, zinc, iron, nickel, and manganese.

"2. The alloyage of .03 part of tin with 58.10 parts of copper, .09 part of lead, 18.90 parts of zinc, 1.28 parts of iron, 20.62 parts of nickel, and .98 part of manganese."

388,181. Galvanic Battery. Howard Cassard, Baltimore, Md.

The first claim is given: "1. A galvanic battery consisting of a jar having an acidulated exciting fluid, a porous cell or bottle immersed in the same and containing an oxydizing agent, and an oxydizable metal and an electrode, both immersed in the same exciting fluid."

388,242. Pneumatic Intermittent Circuit Closer. William C. Barney, New York, N. Y.

The first claim follows: "The combination, in a pneumatic instrument for sending intermittent impulses of electricity into a conductor, of a tympan in a case having an air passage extending around the tympan, so that the air waves will act first on one side of the tympan and afterward on the opposite side of it, an electrode in the center of the tympan and at each side thereof connected with one pole of a battery, and two electrodes connected with the other pole of the same battery and placed opposite to each other and to the intervening electrode on the tympan."

388,244. Printing Telegraph. Jean M. E. Baudot, Paris, France.

The first and last claims are given: "1. The combination in a receiving instrument, of a series of figures with a combiner moving relatively to them and formed with rows of indentations (or equivalents) traversed by the fingers and arranged to be engaged by the latter according to as many different combinations as there are characters to be transmitted.

"28. The combination of a manipulator consisting of five keys assembled in one instrument, a distributor for connecting said keys successively to line, a receiving instrument having five magnets for receiving the five successive currents, and a distributor at the receiving station for distributing the five successive currents to the respective magnets, whereby thirty-two different signals may be transmitted by depressing the manipulator keys in different combinations."

388,245. Methods of Working Metals by Electricity. Nichlas Benardos, St. Petersburg, Russia.

The claim follows: "In the hereinbefore described process of welding or working metals by means of the electric arc, the method of improving the metal and enhancing the efficiency of the arc, which consists in subjecting the same to the influence of an electro magnet, in the field of which the arc is maintained during the welding operation."

388,246. Apparatus for Working Metals by Electricity. Nichlas Benardos, St. Petersburg, Russia.

388,247. Current Collector for Electric Railways. Josiah L. Blackwell, New York, N. Y.

388,283 Multiple Switch Board. Milo G. Kellogg, Hyde Park, Ill.

The first claim reads: "1. In a telephone subscriber's station outfit, the combination of a battery transmitter, a battery, and a switch, said switch having a pair of contact points which are closed when the switch is in position for the telephone to be used, and not otherwise, the transmitter being in the circuit of the line and being shunted by a branch or derived circuit, in which are said battery and said pair of contact points."

388,294. Electric Gas Lighter. John J. McGowen, Ithaca, N. Y.

388,300. Electric Steering Apparatus for Torpedo Boats. James O'Kelly, London, and Bernard A. Collins, 26 Mitchell Road, Nunhead, County of Surrey, England.

388,312. Battery Zinc. Benjamin Scarles, Clinton, Mass.

388,333, Telegraph Receiver. William T. Barnard, Baltimore, Md.

388,335. Secondary Battery. John Beattie, jr., Westport, Mass.

388,344. Circuit Closer for Call Systems. Charles E. Dey, Denver, Col.

The first claim is given. "1. The combination, in an electric call, of spring-actuated push pins, a movable frame engaged to said pins, and two cam shafts provided with connecting rods."

388,357. Fire Telegraph. John H. Guest, Brooklyn, N. Y.

388,358. Automatic Fire Telegraph. John H. Guest, Brooklyn, N. Y.

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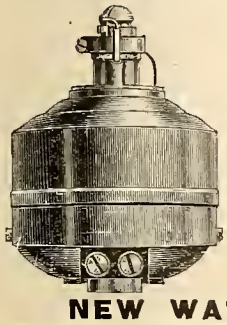

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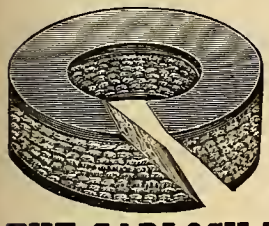

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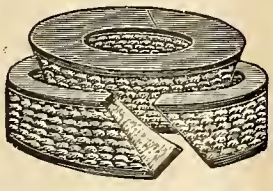

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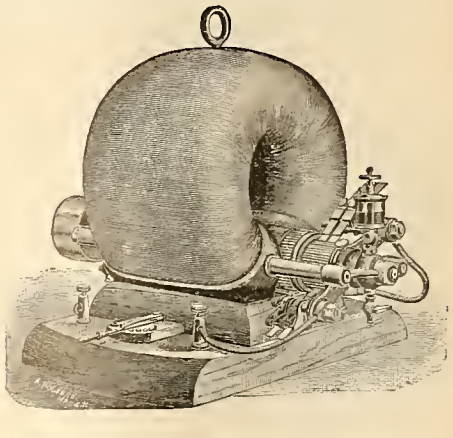

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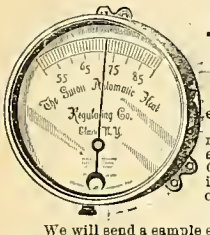
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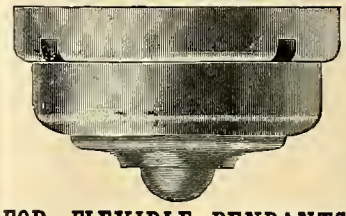
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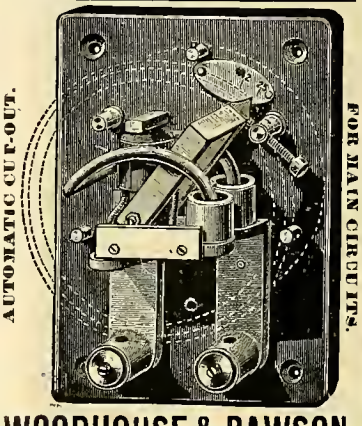

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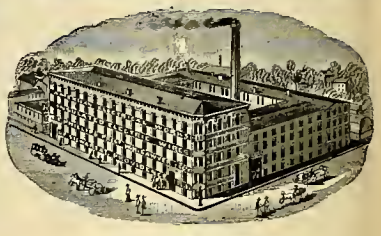
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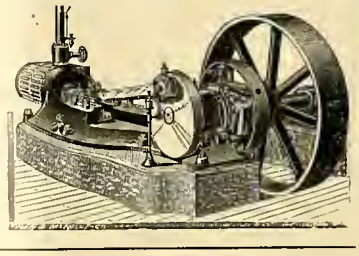

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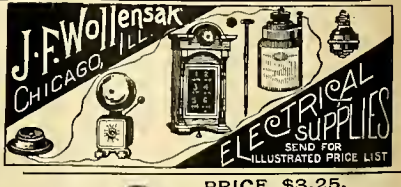

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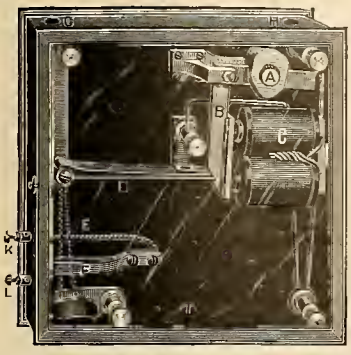

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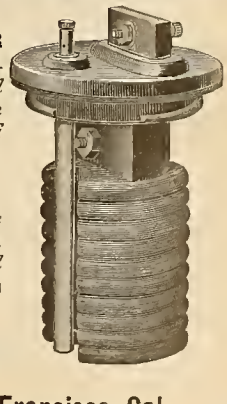

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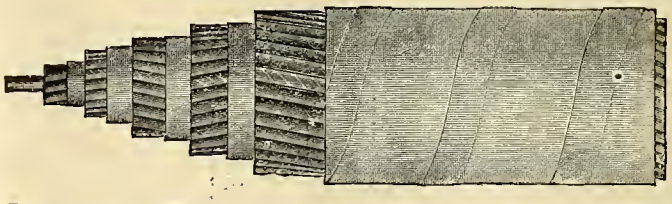

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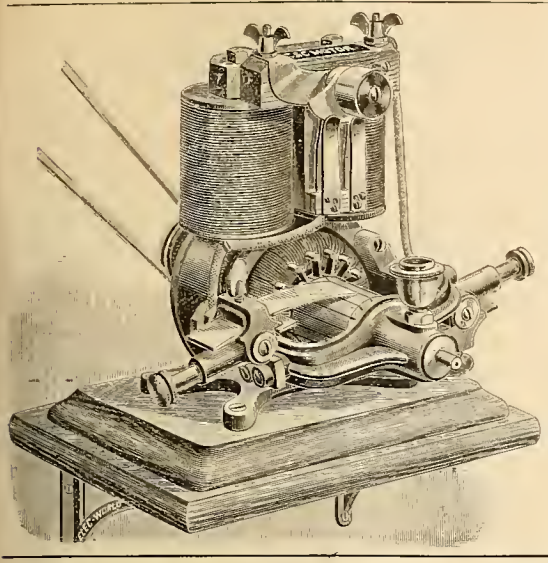

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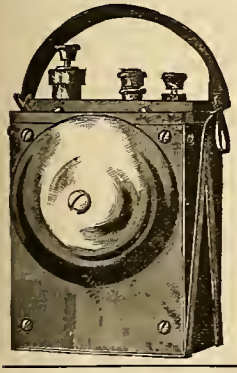

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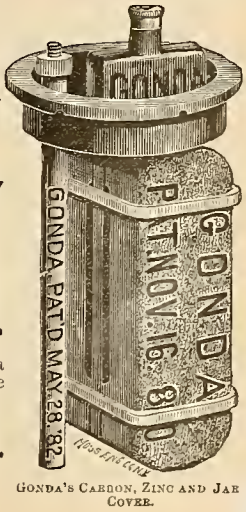

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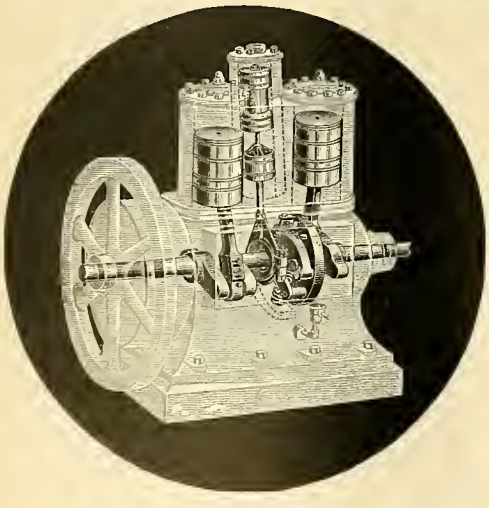

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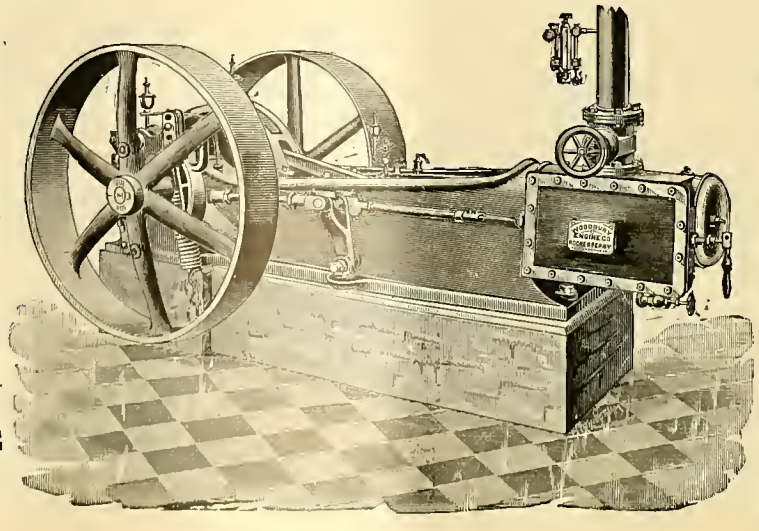

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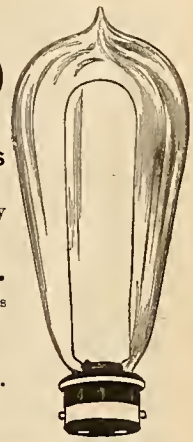

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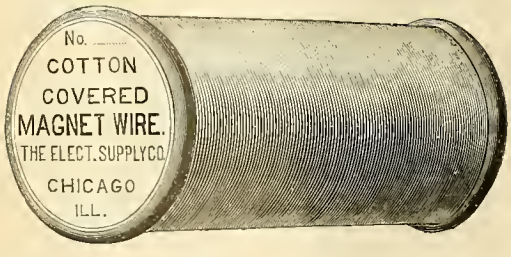

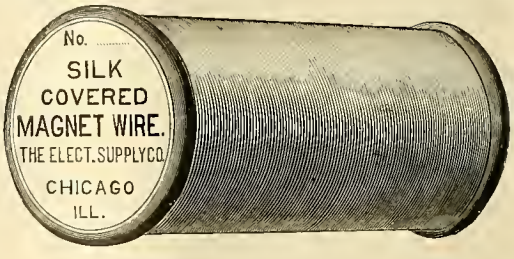

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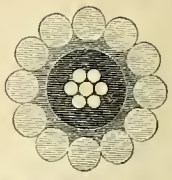

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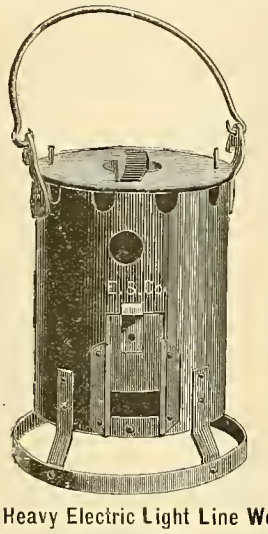

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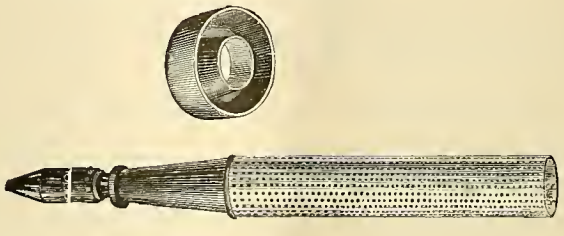

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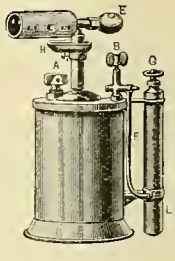

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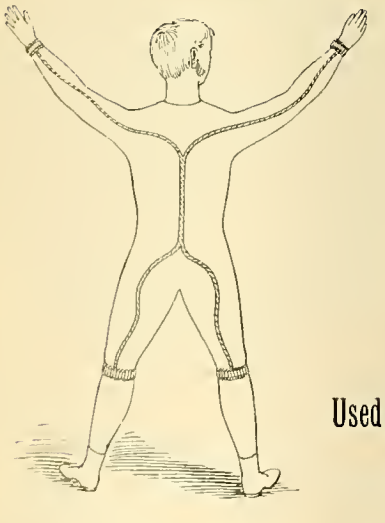

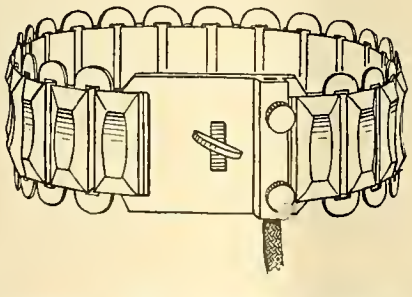

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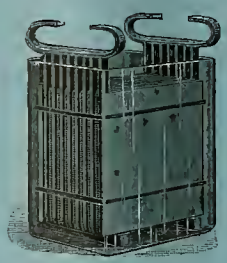

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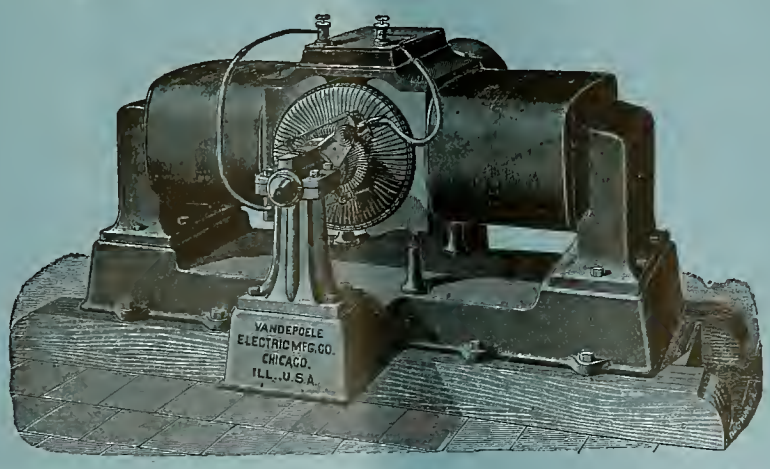

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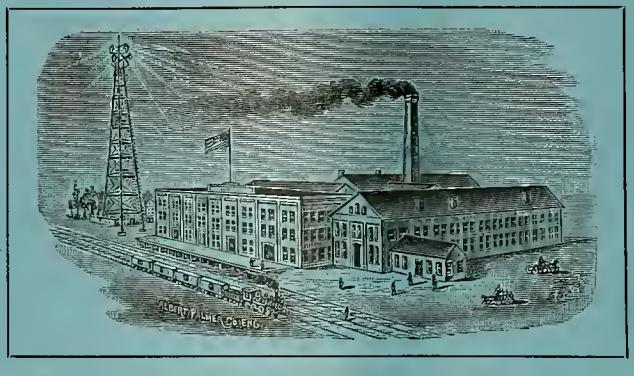

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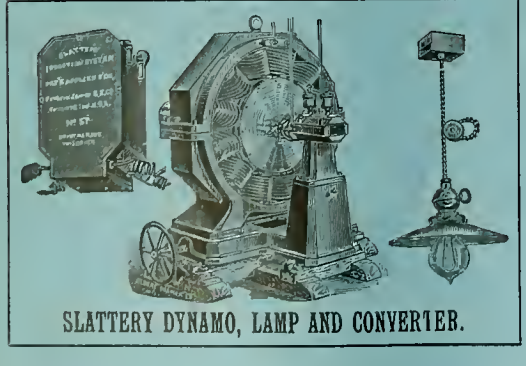

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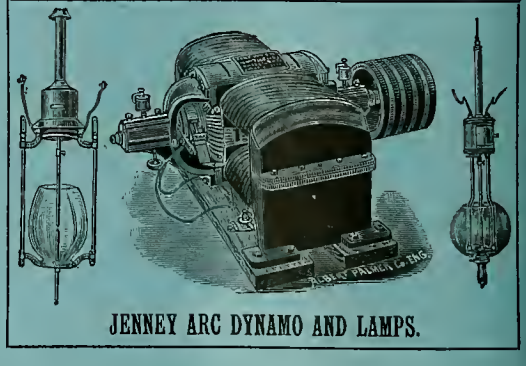

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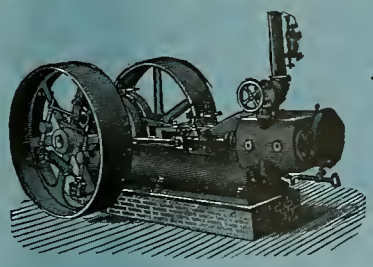

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Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff St., New York. 64 Washington St. Chicago, Ills.

FACTORIES: ANSONIA, CONN.

DANIEL W. MAHMON, President.
ADDISON H. NORDYKE, Vice-President.

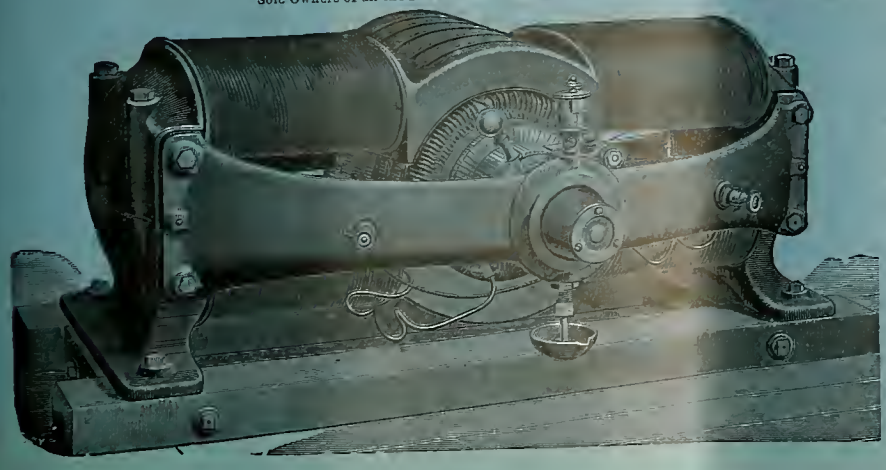
CHARLES D. JENNEY, Electrician.

BRAINARD ROBISON, Secretary.
AMOS K. HOLLOWELL, Treasurer

JENNEY ELECTRIC COMPANY,

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATIONS AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St.

INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

EASTERN OFFICE:
178 DEVONSHIRE STREET, BOSTON.

WESTERN OFFICE:
148 MICHIGAN AVE., CHICAGO, ILL.

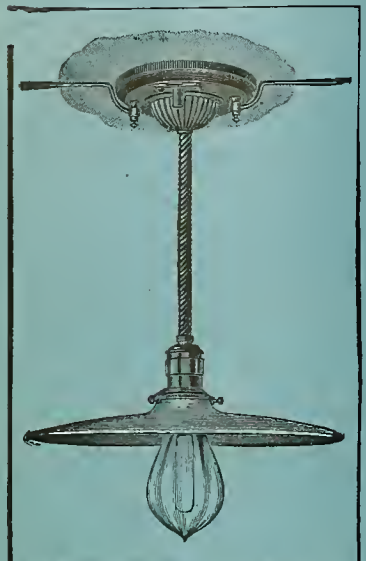
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



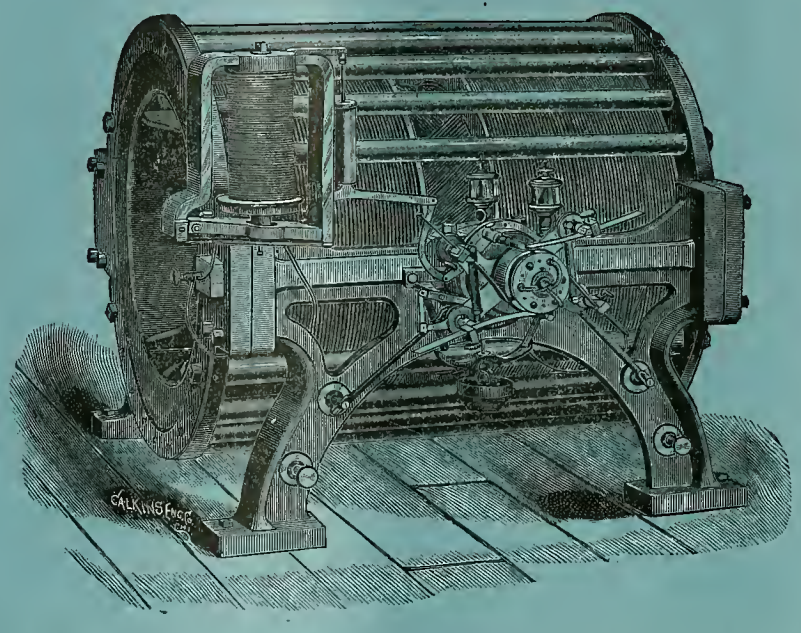
SERIES LAMPS

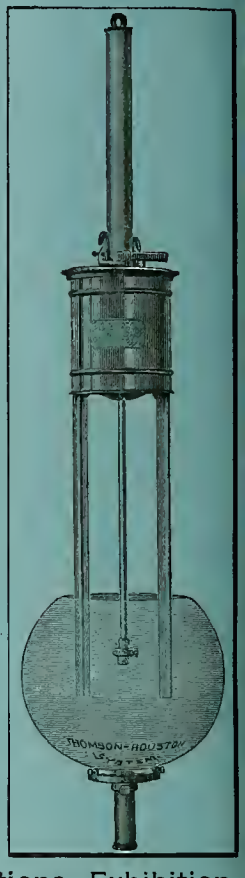
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



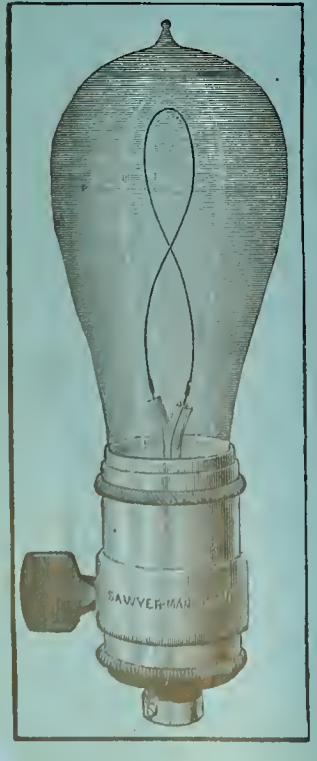


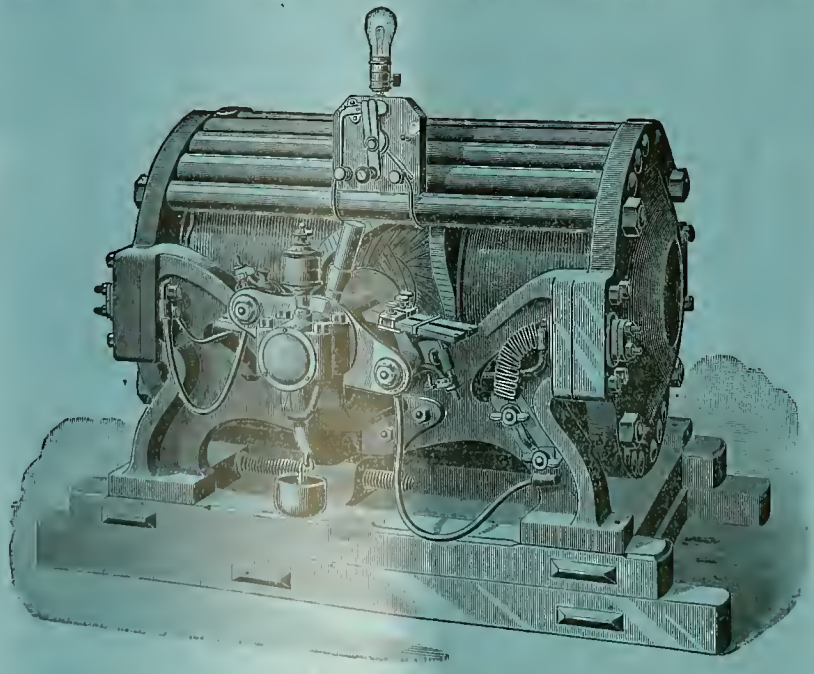
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, NVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,

16 & 18 BROAD STREET, NEW YORK.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals 11 $\frac{50}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals 6 $\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager. 219 LA SALLE ST., CHICAGO.

ELECTRICAL DEPARTMENT

NEW HAVEN CLOCK CO.,

MANUFACTURERS OF

TELEGRAPH, TELEPHONE, ELECTRIC LIGHT, AND GENERAL

ELECTRICAL SUPPLIES.

Hotel and House Annunciators, Burglar Alarms, Call Bells,

MAGNETO BELLS, FIRE ALARMS,

Pins, Brackets, Cross Arms, Insulators, Batteries, Etc., Etc.

—IN STOCK—

Full Line of ALFRED E. MOORE'S INSULATED WIRES, CABLES and CORDAGE.

G. A. HARMOUNT, Western Agent,

315 to 321 WABASH AVE., - - - - CHICAGO, ILL.

BOSTON, NEW YORK, SAN FRANCISCO, LONDON, LIVERPOOL, KOBE, YOKOHAMA, JAPAN, SHANGHAI, CHINA.

THE NATIONAL CARBON CO.

CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

JARVIS ENGINEERING COMPANY,

61 OLIVER ST. BOSTON. | 81 LAKE ST., CHICAGO. | 109 LIBERTY ST. NEW YORK.

H. A. CLASIER. Manager Western Dept.

CONTRACTING ENGINEERS FOR ERECTING COMPLETE STEAM PLANTS FOR

Electric Light and Power Stations

NATIONAL FEED WATER HEATER,
JARVIS BOILER SETTING, to burn Anthracite Coal and Coke Screenings
NATIONAL ROCKING and SHEFFIELD GRATE BARS.

SEND FOR NEW CATALOGUE.

POND ENGINEERING CO.,

707 and 709 Market St.,
ST. LOUIS, - MO.

BRANCH:—600 Walnut St., Kansas City, Mo.

ENGINES, BOILERS, ETC., FOR DRIVING DYNAMOS.

COMPLETE STEAM PLANTS CONTRACTED FOR,

ERECTED READY FOR SERVICE.

SPECIALTIES:—The Armington & Sims Engine, Steel Boilers, Jarvis Furnace, Standard Rocking and Sheffield Grates, Lowe Heater, Hyatt Filter, Blake Pump, Korting Injector, etc.

SEND FOR LATEST CATALOGUES.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

J. B. YOUNG, President and Treas. B. K. JAMISON, Vice-President.

SOLAR CARBON & MFG. COMPANY,

Office, No. 69 Schmidt & Friday Building, PITTSBURGH, PA.

Well Selected and Good CARBONS made from Natural Gas. Process Patented.

BATTERY CARBONS OF ALL SHAPES AND SIZES A SPECIALTY.

Western Office, 175 Randolph Street, Chicago. Special Discounts on Large Orders.

The Attention of Electric Light, Telephone and District Messenger Companies is Especially Called to Our

NEW TRINIDAD LINE WIRE.

THE UNIVERSAL CONDEMNATION of the so-called Underwriters' Wire and the demand for something better, has induced us to offer our new TRINIDAD LINE WIRE as a substitute for its use, and at a very little higher price. This wire is served with two coatings of our Bituminized Tape and braided over all. A serving of Trinidad Compound is put on between each tape and braid. The outside finish is neat, clean and strong. It will not liquefy or become sticky with heat, nor brittle with cold. The covering is tough and tenacious; will stand rough usage and a rubbing contact without abrasion. We claim that our TRINIDAD LINE WIRE is the cheapest well insulated and most serviceable wire offered for all pole work, especially for high tension currents.

UNDERGROUND INCANDESCENT CABLES.

ILLUMINATING COMPANIES proposing an extension of their Incandescent Plants are invited to correspond with the undersigned before commencing construction. With our recent improvements and reductions in price, the cost of placing large incandescent Cables underground in a solid and substantial manner is brought within actual business limits.

CORRESPONDENCE SOLICITED. PLANS AND ESTIMATES ON APPLICATION.

THE CALLENDER COMPANY have, during the last two years laid many miles of large cables underground, all of which are in actual work. The difference in cost between an overhead and underground system for Incandescent work is now no greater than is warranted by the better service insured by an underground system. The Callender Company's Underground Incandescent Cables and System have been in actual operation for some two years in twelve cities, and are indorsed by all the parent light companies.

Manufacturers also of Insulated Wire for Electric Lighting for House Purposes, and in all places where good Insulation is Required.

THE CALLENDER INSULATING AND WATERPROOFING COMPANY,

ADDRESS:

18 CORTLAND ST., N. Y. 101 LEADENHALL STREET, LONDON.

WESTERN OFFICE, 68 COMMERCE BUILDING, CHICAGO.

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THOMAS WILLIAMSON, SECRETARY. FRANK P. TROUT, SUPERINTENDENT.

THE WOODWARD ELECTRICAL COMPANY,

MANUFACTURERS OF THE

For Light and Power Purposes.

DETROIT STORAGE BATTERY

For Light and Power Purposes.

Estimates for furnishing plants can be had on application to

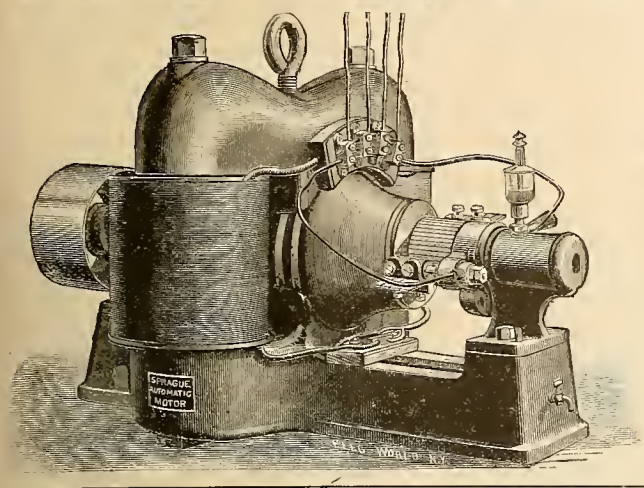
F. B. TROUT,

GENERAL MANAGER.

Offices, 69 Griswold St., CAMPAU BUILDING.
Factory, Corner 13th and Woodbridge Sts.

DETROIT, MICH.

THE SPRAGUE MOTOR.



1250 H-P. of Motors Sold in One Week in July.

MOTORS ADAPTED TO THE USE OF ALL KINDS OF MACHINERY.

Sprague Electric Railway and Motor Co.,

16 and 18 Broad Street, New York.

I. J. DICKEY, President. ISRAEL LOVETT, FLEMON DRAKE, Vice President.
H. J. WELLS, Sec'y and Gen'l Man. Sup't and Electrician. L. H. KORTY, Treasurer.

MIDLAND ELECTRIC CO.,

OMAHA, NEBRASKA.

—DEALERS IN—

ELECTRICAL SUPPLIES

For the Telegraph, Telephone and Electric Light.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learners' Instruments, Medical Batteries, Linemen's Tools, Bell Hangers' Supplies, Railway Velocipedes, Cars, Etc.

WESTERN AGENTS THE OKONITE CO., and the Return Call System of Hotel Annunciators. Fire Alarms for Cities and Towns. We own the Franchises of the Western States and Territories for the

IMPROVED McCULLOH

→*AMERICAN + DISTRICT + TELEGRAPH + SYSTEM,*←

and are prepared to give franchises and construct plants on reasonable terms.

☞Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

Our BELTING is tanned on the surfaces only; the **INTERIOR is RAW HIDE.**

Send for Our Valuable Book for Engineers and Belt Users. Free.
Agents in all Cities. Send for Trial Belt.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

The Empire City Electric Co.

15 DEY STREET,

NEW YORK,

Manufacturers and Dealers

IN ALL KINDS OF

ELECTRICAL SUPPLIES.

High Insulation

In order to meet the constantly increasing demands for

BETTER INSULATION,

THE BISHOP GUTTA-PERCHA CO.

420-426 EAST 25th STREET, NEW YORK CITY,

HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

FOR MAKING THE CELEBRATED

HOOPER'S CORE

AND OTHER RUBBER COMPOUNDS

FOR INSULATING WIRES FOR

Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

HENRY A. REED, Manager.

Use Marks' Compound Wire for Battery Coppers.

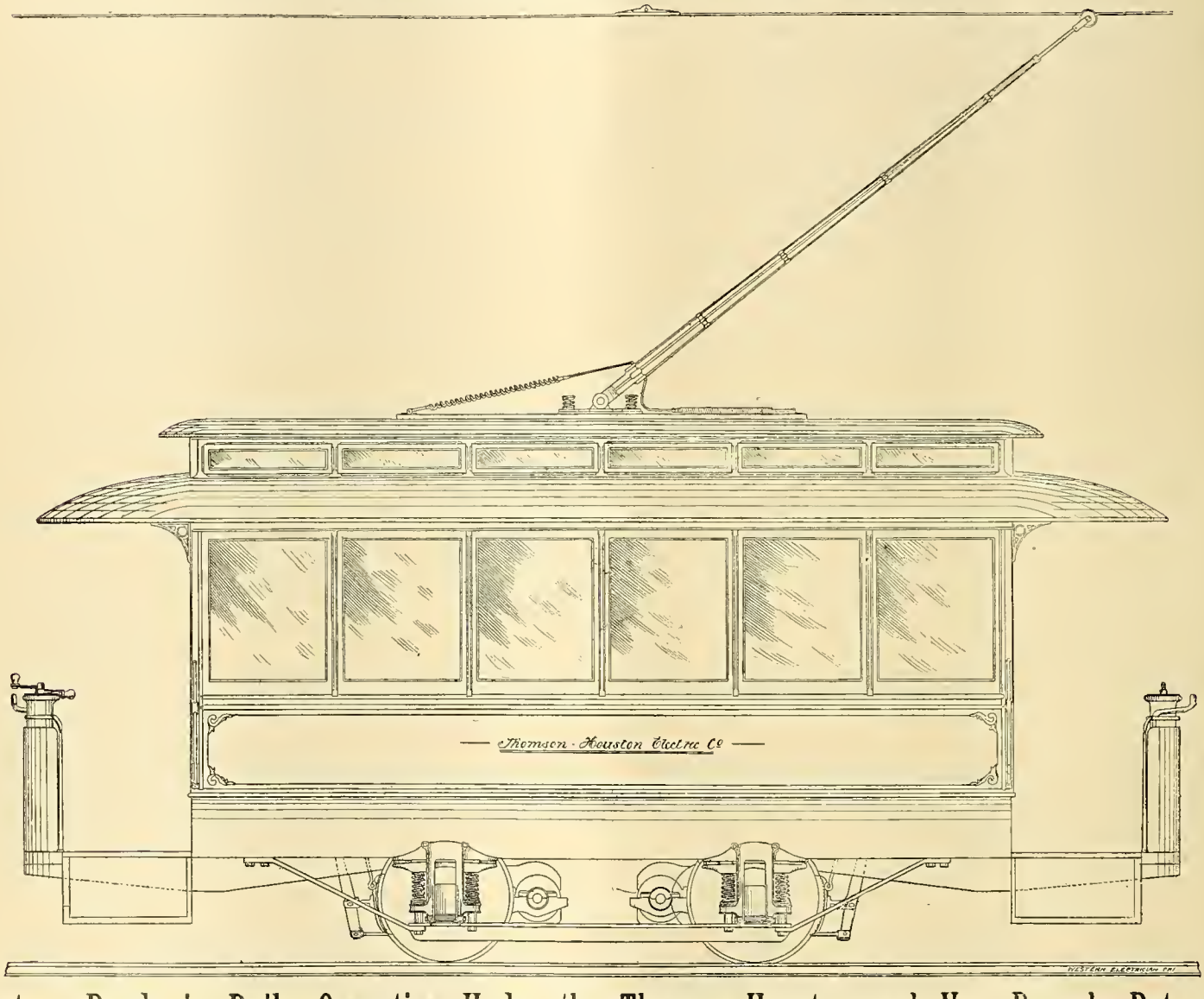
Use Balata Insulation for Flexible Cords.

USE NOTHING BUT

GUTTA-PERCHA FOR SUBMARINE CABLES.

The Thomson-Houston Electric Railway System.

THE THOMSON-HOUSTON ELECTRIC COMPANY HAS RECENTLY PURCHASED ALL THE VAN DEPOELE ELECTRIC RAILWAY PATENTS.



Sixteen Roads in Daily Operation Under the Thomson-Houston and Van Depoele Patents.

ALL MATERIAL IS NOW MANUFACTURED AT THE **FACTORY** *AT* **LYNN,** *MASS., THE LARGEST AND BEST EQUIPPED ELECTRIC FACTORY IN THE WORLD.*

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Van Depoele patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

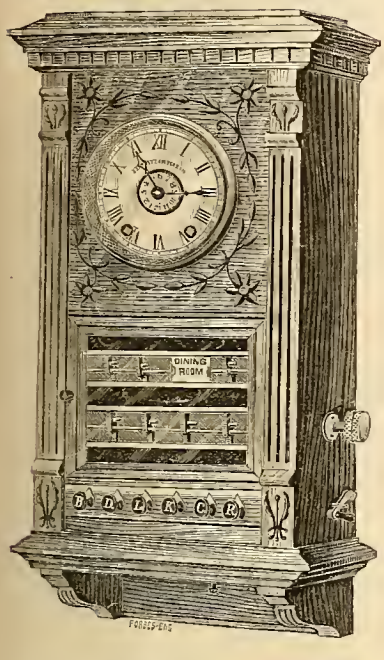
MOTORS & ELECTRICAL EQUIPMENTS FURNISHED FOR MINING & OTHER SPECIAL WORK.

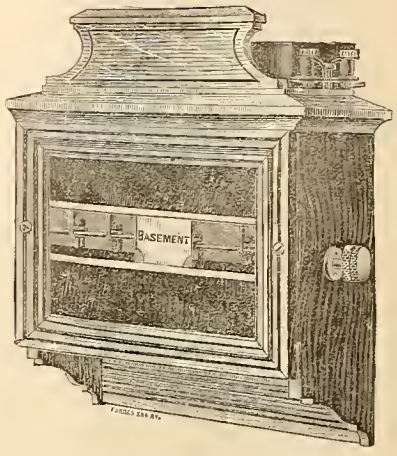
For Full Information and Estimates Address the

THOMSON-HOUSTON ELECTRIC COMPANY,

178 DEVONSHIRE ST., BOSTON, MASS. 148 MICHIGAN AVE., CHICAGO, ILL.

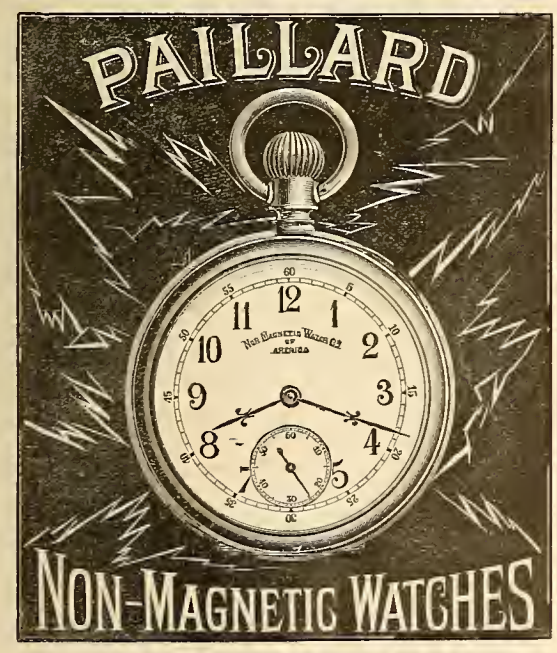
SEND FOR NEW CATALOGUE—JUST OUT.





ANNUNCIATORS, PATENT DUST PROOF BELLS, DOOR OPENERS' LETTER BOXES, PUSH BUTTONS, BATTERIES, WIRE, AND A FULL LINE OF SUPPLIES.

AT PRICES THAT CAN'T BE BEAT.



INDORSED

—BY—

Thomas A. Edison, Elihu Thomson, N. S. Possons, Edwin J. Houston,

AND SCORES OF LEADING ELECTRICIANS.

FOR SALE BY ALL JEWELERS.

Send for Pamphlet "ARE YOU POSTED?" to

NON-MAGNETIC WATCH CO.,

177-179 Broadway, N. Y.

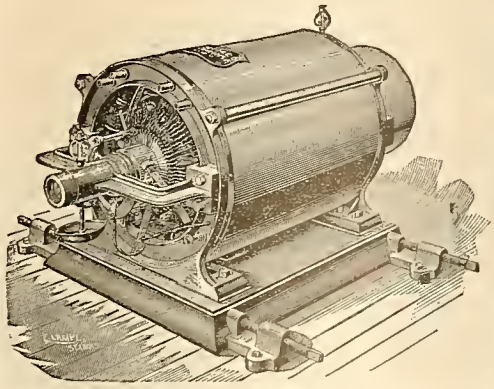
Heisler Electric Light Co.

809-817 S. 7th Street, ST. LOUIS, MO.

MANUFACTURERS OF

The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

Arc and Incandescence

Electric Lighting Apparatus,

Motors and Carbons.

ALEXANDER KEMPT, Special Agent,
No. 130 Washington Street,
CHICAGO, ILL.

O. C. STEELE, Special Agent,
No. 201 Journal Building,
KANSAS CITY, MO.

THE

WESTINGHOUSE ELECTRIC COMPANY,

PITTSBURGH, PA.,

Manufacturers under Patents controlling the Sale and Use

OF

ALTERNATING CURRENT ELECTRIC LIGHTING APPARATUS.

The installment of over 100 Central Station Plants has demonstrated the Alternating Transformer System to be superior to all others, for distributing current from a Central Station over small or large areas for lighting and power purposes.

ALTERNATING CURRENT METERS.

This system is made more profitable than any other by the use of the meter now supplied by this company.

It measures the whole current.

It is strictly a positive mechanical movement.

It registers directly in lamp hours.

It reads from dials like a gas meter.

It consumes no appreciable energy.

It is not affected by temperature or other local conditions.

It is practical, and it is cheap.

ALTERNATING CURRENT MOTORS.

This company has demonstrated that motors run by the alternating current are as efficient as the best direct current motors, and can be run without commutators or brushes, being started, stopped and reversed without breaking a connection.

All parties desiring to secure the most perfect system of electric distribution for light and power are invited to inspect the apparatus at the works of the company at Pittsburgh, Pa., where it will be demonstrated that the Alternating System possesses such advantages over the direct system in regard to efficiency, distribution, safety, life of lamps, and the use of meters and motors, that no purchaser can afford, at any price, to take the direct current apparatus.

WESTERN ELECTRIC CO.

CHICAGO. NEW YORK. LONDON. ANTWERP.

ELECTRIC LIGHTING APPARATUS.

Our System of Electric Lighting is complete in every detail, and is Unexcelled in the Efficiency and Workmanship of the Apparatus; in the Brilliancy, Steadiness and Color of the Light produced, and in Automatic Regulation.

WE FURNISH DYNAMOS TO GIVE ANY REQUIRED CURRENT

The high grade of workmanship and the efficiency of our Dynamos, render them especially advantageous for charging Storage Batteries, furnishing current for Electric Motors, etc. We furnish Arc Lamps adapted to any Arc Current. The superior construction and simplicity of our Lamp render its use advantageous with any system.

AGENTS:

Midland Electric Company	Omaha, Neb.
United Electric Company	Salt Lake City, Utah.
Western Engineering & Electrical Company	Chetopa, Kan.
J. Geo. Kaelber	3 and 4 Duff Block, Denver, Col.
S. F. Bartol	Grand Windsor Hotel, Dallas, Texas.
Electric Development Company	San Francisco, Cal.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, SEPTEMBER 8, 1888. No. 10.

THE CONVENTION

Of The National Electric Light Association at New York.

The National Electric Light association convened in semi-annual session at the Hotel Brunswick, New York, Wednesday, August 29th.

We append a list of members and guests present, and follow with a stenographic report of the proceedings.

MEMBERS AND GUESTS.

Among those present at the convention were:

Ackerman, P C.....New York.
Alexander, P. H.....Boston
Acheson, E. G.....Pittsburgh.
Abakanowicz, B.....Paris, France.
Avango, A.....New York.
Angell, F.....Trenton, N. J.
Ayer, M. B.....Jacksonville, Ill.
Aams, H. C.....New York.
Adams, M. F.....New York.
Bradley, C. S.....Yonkers, N. Y.
Beetle, G. L.....Chicago.
Burdick, J. R.....New York.
Botsford, C. R.....New York.
Bernard, E. G.....Utica, N. Y.
Brown, W. C.....New York.
Barker, M. H.....Boston
Blanchard, Geo. W.....New York.
Britton, C S.....Cleveland.
Butterworth, A. W.....New York.
Barney, C. H.....New York.
Boulton, W. H.....Cleveland.
Baker, C. O., Jr.....Newark, N. J.
Brown, C. A.....Chicago.
Barclay, J L.....Chicago.
Byllesby, H M.....Pittsburgh.
Brooks, David.....Philadelphia.
Bogle, C. H.....New York.
Baird, M E.....Windsor, Conn.
Baxter, G. H.....Pittsburgh.
Boynton, F J.....Boston.
Brady, T. H.....New Britain, Conn.
Bliss, A. E.....Malden, Mass
Brukins, H. D.....Chicago.
Bishop, K. D.....Cleveland, O.
Bradbury, J. Y.....Lowell, Mass
Bigelow, F. L.....New Haven.
Biddulph, W. W.....New York.
Bunnell, J. H.....New York.
Carman, Henry.....Rahway, N. J.
Cadwell, W. D.....Nashua, N. H.
Chenoweth, A. C.....New York.
Cutler, H. H.....Newton, Mass.
Curtair, J. R.....New York.
Cox, S. E.....Cleveland.
Carritt, E. W.....New York.
Chamberlain, J. C.....New York
Cram, H. B.....Boston, Mass.
Callender, W M.....New York.
Conkling, Addison.....New York.
Curtis, H N.....New York.
Candee, W. L.....New York.
Colvin, F. R.....Baltimore.
Curtiss, C C.....Cleveland.
Cullen, W. F.....New York
Church, Wm Lee.....Pittsburgh.
Clark, Walter P.....Boston.
Clark, F. E.....Boston.
Crouse, J B.....Cleveland.
Curtis, G. F.....Lynn, Mass.
Cartwright, F. G.....Utica, N Y.
Cherry, E V.....Cincinnati
Candee, J. M.....Poughkeepsie, N. Y.
Crocker, H.....New York.
Coombs, M.....Youngstown, O.
Collins, W. F.....Boston
Clark, E P.....New York.
Cross, J H.....Johnstown, Md.
Coleman, R.....New York
Calisch, J.....New York.
Card, B. F.....Harrison, N. J.
Cleverly, H. A.....Philadelphia.
Cheever, C. A.....New York.
Chalmers, D.....New York.
Dunton, A. L.....Philadelphia.
Dunn, D. W.....Boston, Mass.
Daggett, H. M., Jr.....N. Attleboro.
De Camp, A. J.....Philadelphia.
Duncan, S. A.....Pittsburgh
Davis, Henry C.....New York.
Dowd, P. A.....New York
Degenhardt, F. E.....Chicago.
De Land, F.....Chicago.
Davis, Isaac H.....New York.
Dillon, T. W.....North Attleboro, Mass.
Dee, J R.....Houghton, Mich.
Edgar, C. I.....Boston.
Eliott, J. F.....New York.
Evans, D. E.....Baltimore.
Edson, Jarvis B.....New York.
Edgecomb, D. W.....New York.
English, J.....Portland, Me
Eustis, H H.....Boston
Eagan, S F.....Buffalo.
Fox, S. J.....New Haven
Francisco, M. J.....Rutland, Vt.
Fee, Hasegara.....Tokio, Japan.
Ferguson, J.....Brooklyn.
Fitzgerald, W. H.....Detroit.
Fleming W. H.....Decatur, Ala.
Foote, A R.....Cincinnati, O.
Garratt, A. V.....Boston.
Godfrey, J. W.....New York.
Gethin, E. B.....Cleveland.
Gennert, E. F.....New York.
Goodyear, M. W.....New York
Giles, W. A.....New York.
Gisborne, M.B.....New York.
Garden, H. R.....New York.
Green, P. R.....New York.
Garnett, J.....St. Louis.
Gallaher, R. E.....New York.
Giles, C. K.....Chicago
Gibbens, D. L.....New York.
Guy, G. H.....New York.
Gates, C. A.....Massillon, O.
Harrington, F. W.....Chicago.
Harding, H. McL.....New York.
Harding, W. H.....Baltimore.
Hapgood, John H.....New York.
Huston, ——.....Chicago.
Hunt, Walter T.....New York.
Hess, Jacob.....New York.
Halsey, ——.....Paterson, N. J.
Heinrich, R. O.....Philadelphia.
Hering, C.....Philadelphia.
Huntley C. R.....Buffalo, N. Y.
Hubbell, R. S.....New York.
Hayes, H. E.....Cleveland.
Hood, W.....Newport, R I.
Hammond, W. F.....Greenport.
Hart, S. J.....New Orleans, La
Houston, E. J.....Philadelphia.
Hurlbut, D M.....New York.
Hoffecker, J. S.....Wilmington, Del.
Haley, ——.....New York.
Hamilton, B. F.....New York
Ireson, C. L.....Boston.
Johnson, G. A.....Hartford.
Johnson, H. H.....Hartford.
Johnston, W. J.....New York.
Keilholtz, P. O.....Baltimore.
Killicutt, D.....Boston.
Knowles, E. R.....Brooklyn.
Kelly, J. F.....New York
Kintner, C. J.....New York.
Kreidler, W. A.....Chicago.
Kinsman, F. E.....New York.
Kerr, W. C.....New York.
Knudson, A. A.....St. John, N. B.
Kelly, W. H.....New York.
King, F. W.....Baltimore.
Kearney, H.....New York.
Lufkin, H. F.....New York.
Lynch, E. T., Jr.....New York.
Lawrence, W. H.....Cleveland.
La Rue, G W.....New York.
Larbig, Theodore.....New York.
Larkin, James.....Baltimore.
Lugo, O.....New York.
Law, M. D.....Philadelphia
Leslie, E A.....New York.
Linnell, H. M.....Hartford.
Lawrence, A. B.....New York.
Logan, J.....Waltham, Mass.
Leonard, F. H.....Elmira, N. Y.
Leam, G. H.....Boston.
Latshaw, Z.....New York.
Longwell, H. E.....Chicago.
Lane, J.....New York.
Mason, Dr. A. F.....Boston.
McGrath, W. H.....New York.
Martin, R. W.....New York.
McLaughlin, C.....New York.
Mitchell, D. L.....Taunton, Mass.
Moore, A. V. H.....Plainfield, N. J.
Morrison, W. J.....Montreal.
Moffatt, R. R.....New York.
Mace, Theo.....Harrison, N. J.
McIntire, C. H.....Newark, N. J.
Morrison, J. Frank.....Baltimore.
Manson, Geo. T.....New York.
McCoubray, Thos., Jr.....New York.
Martin, T. C.....New York.
Moses, Dr. Otto A.....New York.
McCarty, Norman.....Baltimore.
Magee, Frank A.....New York.
McQuaide, J. P.....New York.
McTighe, T. J.....New York.
Madden, O E.....New York.
McDonald, R T.....Fort Wayne, Ind
McGonnigle, R. D.....Pittsburgh.
Moore, J. J.....New York.
Marsh, E. A.....Waltham, Mass.
Minaham, J. C.....Troy, N. Y.
Morris, R. L.....Nashville, Tenn.
Moss, Theodore.....New York.
Mead, M. M.....Pittsburgh.
McIntire, W. C.....Windsor, Conn.
Morrison, W. J.....Toronto, Ont.
Mayo, G. A.....Chicago.
Markland, J.....Lowell, Mass.
McIntire, C.....Newark, N. J.
Noonan, J. F.....Paterson, N. J.
Nostrand, B. B.....New York.
Olcott, J. F.....New York.
Nichols, E. L.....Ithaca, N. Y.
Newton, A. D.....Windsor, Conn.
Officer, T.....Council Bluffs, Ia.
Pettingell, F. E.....Boston.
Price, Chas. W.....New York.
Porter, Geo F.....Pittsburgh.
Pond, A. C.....Boston.
Pratt, R. J.....Troy, N. Y.
Pope, Ralph W.....New York.
Phelps, Geo. M.....New York.
Pendleton, J. M.....New York.
Phillips, Eugene F.....Providence.
Patterson, A. H.....New York.
Perry, D. P.....Chicago.
Patten, Jarvis.....New York.
Phillips, W. P.....New York.
Peck, Edward F.....Brooklyn.
Perry, C. L.....New York.
Pope, Frank.....New York.
Perry, M. J.....Providence.
Pond, A. C.....Boston.
Perry, C L.....New York.
Pope, H. W.....Elizabeth, N. J.
Ridlon, Frank.....Boston.
Ryan, R. W.....New York.
Russell, D. R.....St. Louis
Rosenbaum, W. A.....New York.
Ross, R. F.....Boston.
Ransom, C. M.....Boston.
Redman, G. A.....Rochester, N. Y.
Rhodes, B.....Niagara Falls, N. Y.
Rennie, A. H.....New York.
Rich, H. G.....Cincinnati, Ohio.
Robinson, R. T.....Providence.
Rosenfield, A.....New York.
Richmond, H.....New York.
Reiber, J. H.....McKeesport, Pa.
Royce, F. W.....Washington.
Rice, F. B.....Buffalo.
Stump, C. E.....New York.
Shay, J. H.....Chicago
Steuart Arthur.....Baltimore.
Swift, Wm. F.....New York.
Scoville, J. S.....Cleveland.
Schieren, C. A.....New York.
Seymour, A. P.....Syracuse, N. Y.
Sargent, W. D.....Brooklyn.
Schenck, U H. W.....New York.
Simpson, J. R.....Philadelphia.
Schlegelmitch, L.....Boston.
Slater, H B.....Leadville, Col.
Stockbridge, G. H.....New York.
Smith, W. F.....Philadelphia.
Stenck, S. G.....Pawtucket, R. I.
Schaefer, L.....Boston.
Swift, F.....Boston.
Stanley, A. F.....New York
Shallenberger, O B.....Pittsburgh.
Smith, T. Carpenter.....Philadelphia.
Spurgeon, Wm.....Baltimore.
Slattery, M. M. M.....Fort Wayne, Ind.
Stone, Frank G.....New York.
Sefton, W. J.....New York.
Sprague, T. W.....New York.
Scott, E. A.....Philadelphia.
Smith, A. M.....Worcester, Mass.
Smythe, T. T.....New York.

Seymour, A. P. ..... Syracuse, N. Y.
Schieren, C. W. ..... New York.
Shaw, —— ..... New York.
Smith, C. D. ..... New York.
Seeley, J. A. ..... New York.
Sanderson, E. M. ..... New York.
Skinner, F. ..... New York.
Shedlock, A. ..... New York.
Stiles, A. K. ..... Chicago.
Timpson, F. C. ..... Auburn, N. Y.
Thornberry, H. S ..... Montreal, Can.
Truex, C. E ..... New York.
Taltavall, J. B. ..... New York.
Terry, C. A. ..... New York.
Van der Weyde, P. H. ..... New York.
Vanderbois, H. S. ..... Utica, N. Y.
Van Rysselberghe, F. ..... Brussels, Belgium.
Wetzler, Joseph ..... New York.
Weeks, E. R. ..... Kansas City.
Waldo, Dr. Leonard ..... New Haven.
Wheeler, S. S. ..... New York.
Whipple, Fred. H. ..... Detroit.
Wightman, M J. ..... Lynn.
Wiley, G. L. ..... New York.
Wilkes, Gilbert ..... Baltimore.
Worthington, Geo ..... New York.
Waterhouse, F. G. ..... Hartford, Conn.
Wilkins, F. H. ..... New York.
Whitney, L. C. ..... New Britain, Conn.
Williams, J. ..... New York.
Wirt, C. ..... New York.
Wightman, E. T. ..... Danbury, Conn.
Woods, G. T. ..... Cincinnati, O.
Warner, B J. ..... Brooklyn.
Wenstrom, Jonas ..... Orebo. Sweden.
Wilson, E. W. ..... New York.
Weed, C. K. ..... Hartford, Conn.
Wilcox, C. H. ..... New York.
Wetmore, J. A. ..... New York.

Wednesday's Proceedings.

The convention was call to order at 12 o'clock, noon, August 29th, by President Duncan, who spoke as follows:

President Duncan's Address.

Gentlemen:—When this association, after six months of its existence, last met in this great city of New York, three years ago, but sixty gentlemen were present. To-day we are over 300; in other words, the attendance has increased five-fold. I am therefore able to congratulate you upon the growth, prosperity and stability of this organization, in whose welfare we are all so deeply interested, and in whose commercial usefulness we all take pride, for we all had a hand in its making. And I am also able to congratulate you upon that which is more important than numbers—the fact that this association is rapidly becoming the center of all matters pertaining to the arts, which depend on the application of powerful electric currents, and that its proceedings are watched with growing interest by not only the whole electrical public of this country, but also abroad It is sometimes interesting to notice how we are regarded beyond those limits which properly come within our jurisdiction; and I would call your attention to a fact, which is certainly not uncomplimentary, that although during the early days of our history the technical papers abroad paid no further attention to our proceedings than to ridicule them, yet of late, and more notably for the last six months, almost every paper which has been read before this association has been copied by the leading electrical papers all over the world. Can there be a stronger indication of the growth of the industries which have been fostered by this association than the fact that they support in this country no less than eight journals devoted exclusively to electrical matters. This prosperity, upon which we have been mutually congratulating ourselves, has been due not only to the commendable efforts of the rank and file of our membership, but also, in no small degree, to the good judgment, perseverance, untiring energy and marked ability of our honored past president, J. F. Morrisson, and the able committees which have assisted him in administering the affairs of this association.

But it is of more importance to us to consider the present state of the industry. From time to time statistics as to the amount of electric light apparatus in use in this country have been presented to the association. At Pittsburg it was estimated that there were no less than 4,000 isolated plants and central stations operating 175,000 arc lights and 1,750,000 incandescent lights. To these figures we may now add 1,351 new isolated plants and central stations operating 35,201 arc lights and 292,944 incandescent lights, of which I have a detailed record. By adding this increase to the figures of six months ago we find that there are now 5,351 isolated plants and central stations, and there are burning every night in the year in the United States no less than 192,500 arc lights and 1,928,000 incandescent lights. We may also add that there are 459,495 horse power of steam engines devoted to electric lighting. Figuring this in coal consumption it can be demonstrated that in the year of 1888 enough coal will be consumed in the United States for electric lighting purposes to make a solid column 100 feet square and over a mile high. It may be here parenthetically remarked that there has been an increase in the capitalization of the electric light companies of the United States in the last six months of not less than $342 210,100.

But we have not yet touched upon the great industry of the electrical distribution of power. There are at the present time, of which I have a record, thirty-four electric railways completed and in operation in the United States, having an aggregate of 138 miles of single track, and operating 223 motor cars and utilizing 4,180 horse power for stationary engines. There are also now in process of construction forty-nine other electric railways, aggregating 189 miles of single track, which will operate 244 motor cars, and at the present time there are are constructed, and being constructed, eighty-three electric railways, aggregating 327 miles of single track, and operating 467 motor cars. In this connection it must be remembered that there are thirty-nine other electric railroads incorporated which have not yet begun construction. It is also estimated that the electric cars now in operation in the United States will carry in the year 1888 no less than 17,045,500 persons. It can be better imagined than estimated what will be the ultimate outcome of an industry which has arrived to such a degree of development in three years.

In view of the difficulty of compiling statistics on such small unities it has been impossible to collect reliable information relative to the stationary motor business; but we know that at the present time it has stimulated capital to such an extent that there are single factories employing no less than 1,500 hands each in the manufacture of electric motors, and, at no far distant day, all large cities will have their power stations of several thousand of horse-power each, distributing energy throughout every ramification of industry. So rapid a development of this new industry into gigantic commercial proportions should be an admonition to the electric light companies now in the field to reap the harvest which is "white to their sickle," and not to wait for competitors to come within their field of operation in the shape of power stations, for these people once established will reach out and take in a large portion of the electric lighting business.

The present meeting of this association gives promise of being one of the most interesting so far held. The report of the secretary and treasurer shows the association to be in a gratifying financial condition, there being a balance of $1 000 in the treasury after the payment of all bills, and the membership is steadily increasing. The proceedings of the last four conventions have been printed and furnished with a thorough cross-index, and each member has been provided with a copy. The admirable way in which the proceedings has been printed reflects credit upon the executive committee, under whose direction it has been carried out, and the carefully compiled cross-index and the accurate technical proof reading, deserve creditable mention. The report of the executive committee, through its chairman, Dr. Otto A. Moses, and the reports of the several committees, together with the following papers, should command the closest attention of the entire convention.

The difficulty of obtaining reliable statistical information in regard to the various electrical industries, and also for the purpose of giving continuity to the whole association from one convention to another, warrants the president in urging upon the association the necessity of establishing a permanent office which shall be a repository of all information relative to the allied electrical industries and a means of inter-communication between its members, and from which the officers and executive committee can administer the affairs of the association. This office should contain a good reference library of electrical works, complete files of all domestic and foreign electrical journals, and the repository of the archives of the association. It should be a place where every member of the association should feel at home, and where he would naturally go for any electrical or other information that it contained A very slight increase in the running expenses of the association would maintain such an office, and when established it would, from its innate value, increase the membership of the Association to such an extent that the running expenses of such an office would take care of themselves.

Does not this association, having, during its years of growth, spread its roots widely through the electrical industry of this country, stand upon the eve of becoming much more widely influential than ever before by carrying out the suggestion of Frank Ridlon, at the convention in this city three years ago, which was further elaborated by a committee specially appointed for that purpose, which reported, through its chairman, Dr Otto A. Moses at the Detroit convention, and was still further advocated by Arthur Steuart, E. R. Weeks and A. J. DeCamp at subsequent conventions—namely, the establishment of a permanent headquarters, as sketched.

Gentlemen, in conclusion, I will say that in no way can you better assist the chair in the discharge of his duties, and in no way can you aid in making this convention a thoroughly successful one, than by a constant attendance at its sessions. I know that the more than generous hospitality in the shape of various entertainments, as mapped out by our New York friends, may tend somewhat to distract your minds from the serious business for which you have assembled, but I also know that you can find ample time, not only to accept of their hospitality, but to give to this convention your entire time and attention during its sessions.

The President—Gentlemen, it affords me great pleasure to have with us this morning a gentleman of national reputation, with whose name you are all familiar. I have the honor of introduding the Hon. Abram S. Hewitt, mayor of the city of New York.

Mayor Hewitt's Welcome.

Mr. President and Gentlemen of the Convention:— My duty on this occasion is as easy as it is agreeable. I am here to bid you welcome to the city of New York and to tender you such hospitality as the mayor of this city has in his power to tender to distinguished strangers. I think the usual form is to give the freedom of the city in a gold box. If you will leave out the gold box, I can tender you the freedom of the city, but exactly what it is I do not know. [Laughter.] But to those who are strangers here I trust it will be found exceedingly pleasant and highly profitable. I gather from the remarks of your president that you are here to take an account of stock of what you know about electrical science and its application to useful purposes. I think it will be easier for you to ascertain how much you know than to find out how much you do not know about this subject. [Laughter and applause.] And in the last part of that inquiry I am in entire sympathy with you. [Laughter.] When I have professed, as I had to do on various occasions that I did not know anything about this subject, it has been received with incredulity, but you who know something about it, know that I am exactly right. When you reflect upon what you have to do you must be rather appalled at the magnitude of the contract. This convention must strike the average uninstructed mind pretty much as a meeting of astrologers in the ante-Christian era would have done throughout the orient, or a convention of necromancers and magicians during the middle ages. You deal with something to the popular mind very mysterious, almost incredible. You have already performed wonders, which even to the most intelligent men can only be regarded as miraculous. You stand to-day pretty nearly in the condition in which Watt, one hundred and ten years ago, must have found himself, when he produced the first perfect condensing engine. Crude forms of engines had been in use doing more or less effective work prior to his day; but in 1776, the year of our emancipation from foreign control, Watt produced the first real working machine, Now, what has been done in one hundred and ten years? There are still living in the world men who were alive when the first engine began to do its work. Could any man—if he had been gifted with the power of prophecy—have foreseen the transformation which the whole world would undergo in a century from the time of that great invention? Can you conceive of the world without a steam engine? Could the population which now inhabits the globe survive for sixty days if the steam engine were withdrawn from use? Would civilization have even an apology for existence to-day without the steam engine? Looking back you can see how the application of one great motive force can transform the face of the universe. Looking forward is there a man here who can tell us what this new electrical force is going to do for the world? Can any man say how it is to be enriched; how it is to be purified; how it is to be exalted from the depths of poverty and suffering in which in many parts it is plunged? If electricity, like air and water, could be made free to the hand of labor or to the wants of men; could be turned on tap, so to speak; either without charge or at a merely nominal cost, don't you see that all monopoly would cease to exist!, For monopoly consists in nothing but the power to appropriate force to personal and private use. If all force and all power were made free to all men, isn't it apparent that the inequalities of fortune and almost all the evils of which mankind complain would disappear? Is there anything more astonishing in this prospect than in the retrospect which you can all take of the work that has followed the introduction of the steam engine? I used to be told when I was at school—I don't know how it is now—that the earth is a great magnet. You may have changed all that, but I hope you have not for I do not want to lose what little I do know. We used to be told it was a great magnet, and that it revolved on its own axis once in twenty-four hours, and that it was twenty-five thousand miles in circumference. Now, that strikes me as the definition of a mighty large dynamo. If a great magnet 25,000 miles in circumference is put in revolution so as to turn on its axis once in twenty-four hours, from what I have seen of the dynamo it strikes me that there must be a vast, incalculable fund of electricity produced by that operation. [Applause.] I know nothing about it, I may be talking nonsense; but at the same time, if that be true, and if it be true of the whole planetary system, and of the whole universe of the Divine Architect, what a vast fund of unappropriated power there is for mankind in the future; and knowledge is power and power is wealth, and wealth, which is free to all who have the brains to take it, is the benefaction of mankind, and the opening of the gates of the millennium, if we are ever to see it, will be accomplished by you and those who will come after you, for this is the only course that I am able to see by which the goodness of God—the bounties of Divine providence can be distributed with a free hand to all the world and to every man, woman and child within its bounds. [Applause.]

Upon the borders of this land of dreams we stand. You are slowly raising the curtain of the future. I shall not see the drama played out; but there are men in this room who will live to see society transformed by this new agency; for it is a curious and suggestive fact that all moral forces and all moral questions find their final resolution in the facts and laws of physical nature. There is where you come at last. If this world is a better world to-day, a richer, a happier, a more enlightened world to-day than it was a hundred years ago, it is due mostly to the steam engine and its applications. If it is to be, as I believe it is to be, a better world, year by year and century by century, it will be due to the discoveries and applications of electrical force, or of some other force which possibly may be hereafter ascertained and developed; but to-day we must call it by the name which you and I know it by—the electrical force.

Hence I bid you welcome to New York. I am glad to see you. You are benefactors. You come to two millions of people with a gospel. You are the apostles of a new industrial dispensation. You are distributors of this evergreen wealth which you hear is in a few hands in this great city. It cannot stand your attacks. It has withstood the preacher and the moralist and the philosopher; but it will not stand against the scientist who discovers the laws of nature, and who makes them free to all who drink at the fountain of science. [Applause.] Yes, you will revolutionize the warld; you will regenerate society, and it is none the less to your credit that while you are doing it you are making your living and getting an honest compensation for your labor, for it is a law of Divine Providence that utility and beneficence shall march hand in hand down the highways of civilization. They are bound together by a divine law and you are the executors of that law when you open new fields of discovery, new forms of value, new applications to useful purposes. Of course we bid you welcome, and we bid you welcome because we feel that we are so ignorent and need your help. We are engaged in this city in undertakings which require from you your honest and best judgment. We send messages by wire through our streets. We light them by conductors perched upon poles through the streets. We talk through a network of wires so thick overhead that often the sky is obscured. They

are not pleasant to look at, but they are indispensable, in the present state of knowledge, to the business of society. (Applause.) The men who would disturb them until something better is found out and proved to be found out would be a barbarian. Still, like the mayor, they have got to go. But the mayor is too old to go at a 2:40 gait, and he likes to see his way clear before he takes a step. Now, in order to clear up this matter a little for you who know so little, as I have said, about this subject, and I knowing so much, let me say, that this much seems to have been found out at some cost to some one, I do not know who. It is quite feasible to put underground all the telephonic and telegraphic wires, and in fact all wires which carry low tension currents. I suppose that is now demonstrated, and I trust that in a very short time this city will be relieved from the unsightly telegraphic wires, telephonic conductors and from any modes of diffusion for arc lighting which may still remain above ground. I suppose that is all feasible. The question what to do with the high tension currents remains. First, we ask you to tell us — at least to tell me, because there are some persons here who know more than I do — whether a satisfactory mode of cable transmission for high tension currents underground has yet been devised. I understand that a cable for the Brush company is about to be laid in one of the conduits which have been constructed in Broadway, and I suppose that will test the question as to the feasibility of the transmission of high tension currents practically and economically, because there is no sense, you know, in things that don't pay; if it is too dear we have got to give it up. I suppose that that will test the question, and I am very glad of it. I have been censured—possibly by you electrical gentlemen—very much, for not having taken steps to coerce all these lighting companies into putting cables underground until that question was settled. Well, I am no longer a young man. I have had a long experience in life. I have done a pretty large business in my time. I have had to deal with very difficult problems, and I have learned that the part of wisdom and of true speed is to go slowly and to ascertain your facts and get your knowledge, before you undertake to reconstruct the universe. I have been very desirous that this matter of transmission of high tension currents underground should be tested at the earliest possible moment, and I congratulate you on the fact that it is going to be tested by a responsible company, and until it is tested, let me say to you frankly that if it were in my power to compel the other companies to do this thing now, to-day, I would not do it. I should look upon myself as an everlasting fool [laughter], who ought to be consigned to eternal seclusion in a madhouse, if I did such a thing. But I hope it will succeed, and if it does succeed no public officer will be more prompt than I in compelling every electric light company to respect the intention of the legislature when it confided this great work to four men who did not know anything about what they were going to do. [Applause.] The legislature evidently recognized the fact, which you recognize and I do, that what we don't know about electricity is a good deal more than what we do know about it, and so they picked out some men who were supposed to understand politics if they did not know anything else. [Applause.] I speak thus frankly, because I am one of the four men. [Laughter and applause.] I should be the last man to cast any imputations upon my colleagues who have charge of this most interesting and important public work; but I think that we shall all of us be wiser—my colleagues as well as myself—after a little more experience has been gained upon the subject to which I have referred.

Now the second question is this: When the cable is under ground and works successfully, will you kindly inform me and the public, through whom I communicate with you, whether a satisfactory system of distribution has been discovered and put in practice? It is one thing to put the current under ground and another thing to get it out so that there may be lights. Now, I know nothing about it; I have simply made inquiries of every intelligent electrician that I could meet, and up to this time I have not been able to ascertain that there is a satisfactory mode of distribution. Now you know whether there is or not. If you should say to me, after a discussion of the subject, that there is, I should accept your judgment as final, because you embody all there is known of this abstruse subject, and if you, by your resolution, say that there is a proper and comprehensive system of distribution, so that the evils that are complained of will be abated and that there will be absolute safety in the distribution, then my mouth will be closed and I shall act upon your judgment; and that is the reason why I have come here, chiefly, to-day, not simply to welcome you as strangers and guests from abroad, but to ask you to consider this subject coolly, dispassionately, intelligently, and give us the results of your discussion, so that we may act coolly, dispassionately and intelligently in carrying out the law.

Now as to the matter of danger. The newspapers have teemed during the last year with sensational articles pointing out the great danger of the present system. Remember I do not like the present system. I regard it as—I was going to say—barbarous. The streets should not be defaced. We should not have these wires running about. But let us get at it on proper grounds—æsthetic grounds, if you will scientific grounds, economical grounds, or any other grounds than prejudice and sensation. Those I take no stock in, and I will never allow myself, and I trust no man who is a lover of truth will ever allow himself, to be dragooned by the newspapers into doing what he believes to be wrong. Now, is this dangerous, will you kindly tell us? I thought it was exceedingly dangerous; I went into office with the impression that every man who went out in a street lighted by a high tension current took his life in his hands, and I was as anxious as any one to get them removed; but when it became my duty to look into the matter I found that in proportion to the amount of work done, measured by our friend the president's column of coal, if you like, or by those other things that you call ohms and volts, and which my colleagues are flinging at the common council pretty much as that distinguished millionaire at Saratoga turned out his gems among the boys the other day, [Laughter.] I am sorry I was not there, by the way; I was about fifty miles away; when I heard of it I made tracks, but I could not get there. Perhaps my colleagues got there [laughter.] Well, I found, measuring this industrial element—call it what you like—by the work it was doing, and ascertaining the accidents that occurred, to my astonishment I found that we had more accidents daily from the horses in the streets—infinitely more; that we had more accidents with steam engines; that even the building of houses in the city caused more deaths every year, infinitely more deaths in the city, than this particular agency. I was therefore driven to the conclusion that, considering the work it was doing, comparing it, if you like, with the illumination by gas, that it was positively safer, just as the railway had proved to be safer than the stage coach, and the stage coach probably safer than walking, for the number of persons carried. I found that with all the difficulties with this thing, the absolute results seemed to show that it was absolutely safer than any other useful agency at work in this city. I may be wrong; but that was the conclusion to which I was forced. But then when I investigated the cause of the accidents I discovered that they were not due to anything that was inherent in the transmission of the current overhead; it was rather due to two causes, either the carelessness of the company in inspecting its insulation and keeping it in good order, or in the carelessness of the person who came in contact with it. Now, there is no excuse for the company — not the slightest. They undertake to render a public service; they are paid for it; they undoubtedly ought to see that their plant is in the most perfect order possible, and any company that neglects to keep its plant in proper order is of course liable to the penalties of the law, and I would be the first to have the officers of such a company indicted, if I could. But I take it that the duty has been on the whole pretty well performed, because the accidents have been so few. They have been very few indeed. I believe that in this city there are but four cases of death in consequence of any difficulties with the wires themselves. There may have been some other causes, but I think there are only four direct deaths. I may be in error. It is either four or seven, but I believe it is four. Now under the circumstances the thing that would seem to be wanted—and I think it will be wanted when you come to your plan of distribution just as much as it is wanted now—is a thorough inspection of the means by which the light is made available to the public above the ground, and that inspection should in the first place be made by the companies themselves, who have the greatest interest in the matter and the largest duty to perform; and I fully agree that the public, who have a great interest in it, should also have thorough inspection, and the reasonable rules and regulations which may be adopted by the body that is charged with the custody of this matter, should be implicitly obeyed, and any violation of them severely punished. But I would like you to consider the whole question—not merely the distribution—but if you come to the conclusion that no adequate mode of distribution has been found which will dispense with the present mode, then that you will consider and advise us how we can make it safer to the public and thereby more economical and useful to the companies who supply the lights. These are questions of such paramount interest in this city that your presence here is most welcome. I trust you will give us the benefit of your knowledge, and when you do not know I hope you will say so and confess your ignorance like men, for that is what I have been doing now and what I intend to do so long as I am mayor. Gentlemen, you are welcome to New York. [Applause.]

THE PRESIDENT: Your honor, in accepting on behalf of the association the freedom of the city of New York, I desire to confess that I do not know what it is, but I might state to your honor that in some of the cities where we have been, the association have practically taken control of the city for the time they have been in it. They have exercised the functions of mayor, board of aldermen and other offices which the American citizen can fill, and they would have taken anything else that was available.

In regard to the consideration of the points brought forward by his honor in his address, I desire to say that this whole question will be considered to-morrow morning at 10 o'clock, when we shall be very glad to have his honor present with us. We have already extended an invitation to the members of the subway commission and others who are interested in this matter, and we are seeking for all the light we can obtain on this subject. We have come to consider this matter calmly, coolly and dispassionately, not only for the interest of the public at large, but for the interests of the electric lighting companies, and I can assure you, sir, that we will consider it in the spirit in which you have suggested

I now declare this convention open for the transaction of such business as may be brought before us.

The first business in order is the report of the secretary and treasurer.

The secretary presented his report showing a balance on hand of $1,945 and a list of 200 members in good standing.

The report was received, and ordered filed and printed.

The secretary read a letter from George Worthington, editor of the *Electrical Review*, inviting the members of the association to visit the "Fall of Rome;" also an invitation from Theodore Moss to be present at a performance at the Star theater; also an invitation from the Okonite company to attend a performance at the Casino; also an invitation from the Electric club to all members to visit the club house during their stay in the city.

C. A. BROWN, of Chicago: I would move you, sir, that a committee of five be appointed by the chair to select the place for the next meeting of the convention of the Electric Light association, and to report to this convention

The motion was seconded and carried.

THE PRESIDENT—We will proceed with the order of business and take up the report of the committee on the testimonial to J. Frank Morrison, of which committee T. C. Martin is the chairman.

TESTIMONIAL TO EX-PRESIDENT MORRISON.

T. C. MARTIN: In accordance with a resolution adopted at the Pittsburgh meeting the resolutions there passed with regard to the services of J. Frank Morrison to the association, have been engrossed. I am chairman of that committee and have the resolutions in my hand, and I believe that it would be in keeping with the wish of the meeting if before presentation of the engrossed resolutions they be read.

Mr. Martin then read the resolutions.

MR. MARTIN: Such, Mr. Chairman, were the resolutions, such the committee, and there is the result of our work. Mr. Morrison, I have the greatest pleasure, in the name of the association, in tendering you the engrossed resolutions, which have just been read. [Applause.]

Mr. Martin handed the resolutions to Mr. Morrison.

MR. MORRISON: This is perhaps the first occasion since my acquaintance—my intimate acquaintance with the gentlemen who composed the National Electric Light association—when I have been glad that I am not very well. I find, at this very agreeable surprise party which you have prepared for me, and which it is a wonder has been kept quiet where so many men knew it, that I am almost unable to talk, and you know what a terrible thing that is to me. I accept the gift which you have presented to me, and I think it is needless for me to say to you that I fully appreciate the spirit in which it is tendered. At the start this association required perhaps different material in its presiding officer from that which it requires to-day. I believe that for the first year I filled the bill fairly well. I do not flatter myself very much. I believe that after the first year a man more bending and more conciliatory than I, perhaps would have filled the bill better. Through your kindness and indulgence I was continued in that honorable office until last February, when you kindly permitted me to retire. For that and the beautifully engrossed resolutions, expressed in such kindly terms, I now thank you. I am not out of the service by any means. I hold the honorable position of a member of the executive committee, and I do not propose to be a dead head in that or any other part of this enterprise. I am at your service, now, gentlemen, as I was before, and I expect to remain in the service so long as the National Electric Light association exists, and I live. I thank you for the compliment. [Applause.]

THE PRESIDENT: The next business in order is the report of the chairman of the executive committee. I see he is now present. You will hear that report.

REPORT OF EXECUTIVE COMMITTEE.

DR. MOSES: At a meeting this morning of the executive committee preparatory to the beginning of our exercises, I announced that owing to the pressure of circumstances and the numerous arrangements that had to be made, I had not been able to prepare a report of the executive committee. A gentleman who has just left here said that sometimes in weakness there may be strength, meaning by that having no report to make, perhaps I might get over it quicker than I might otherwise do. The facts are we have been doing as Dr. Arnold did when he said, "A teacher is a man who is striving all the time to make himself useless." The executive committee of this association has striven so far to become a vanishing point, a zero at this moment, and now the convention has taken the matter into its own hands and the executive committee has disappeared below the surface. Our only function was that which is generally given to executive committees to arrange matters, to bring them into some kind of shape, and chance has a great deal to do with the forming of that. I took, with a great deal of diffidence, the position of chairman of the executive committee. It is our custom always to select the committees as much as possible from the localities in which the convention is going to meet. They forced the duties upon me, perhaps, because they thought I was not as busy as other members of the executive committee, but I find it is a pretty arduous duty to please all, to offend none, to act according to one's best conscience in the matter, to be sure that your reason guides you, to be employed all the time in doing something for the benefit of the association, and in making no mistakes, and I tell you I have had my hands full. Gentlemen, the executive committee has no report to make beyond this, that they deem themselves exceedingly fortunate that the turn of events has allowed the mayor of the city to-day to open up so beautiful a field as he has done. Our business largely shapes itself, and the discussion that will take place to-morrow will be one of great local importance here, and will give zest, I hope, to the entertainments that you will receive of both an intellectual and a physical character. I can only say, gentlemen, that in those I have had a very small part. It was a spontaneous offering on the part of very liberal hearted gentlemen in the city, and I hope you will be able to enjoy them to your hearts' content. Gentlemen, I have nothing further to say.

On motion of Arthur Steuart, the verbal report was accepted.

THE PRESIDENT: The next business in order is the report of the committee on the constitution, of which Mr. A. F. Mason of Boston, is chairman.

At the request of Mr. Mason, the secretary read the report of the committee on the constitution, consisting of A. F. Mason, G. M. Phelps, Geo. F. Porter and Henry D. Stanley. After some discussion by Messrs. Mason, Morrison and DeCamp consideration of the report was made the first order of business for tomorrow afternoon.

THE PRESIDENT: The next business is the report of the committee on insulation and installation of plants. Prof. Thomson and Dr. Moses are on that committee.

INSULATION AND INSTALLATION OF PLANTS.

DR. MOSES—Gentlemen, I appear here on behalf of the chairman of the committee on insulation and installation.

Prof. Elihu Thomson being the chairman. I received the following letter from him, which causes me to speak for him:

"LYNN, MASS., Aug. 25, 1888.

"*Dr. Otto A. Moses, Hotel Brunswick, New York.*

"*Dear Sir:* It will be impossible for me to make any formal report of the work done by the committee on insulation and installation of plants. If you will prepare a brief statement of what was done at the meeting and attach the inclosed schedule of data to be asked for, I think that it will be all that can be done under the circumstances, This might be presented as an informal statement of what was being undertaken by the committee, and the association might then be called upon for the preparation or printing of a number of such blank schedules to be sent to the various electric light companies.

"The spacing in the schedule will need to be modified so as to give more room in some places and less in others for the answers to the questions.

"I am hoping to be able to run down to the meeting, but I may not be there at the time when the report may be in order, and will therefore look to you, if present, to say what you can of the progress made.

"Some time ago I sent a copy of the schedule to each member of the committee, but have thus far received but two acknowledgments. Yours truly,

"ELIHU THOMSON."

Gentlemen, I stood last year in the position of apologizing for the action of this committee and it was the most unfortunate position that I was put in, because I had been somewhat instrumental in organizing it. Everybody, however, was so much occupied with the rush and push of these matters that it was impossible to get what ought to have been obtained with the amount of talent that I was able to suggest should be put on that committee. I was put upon it involuntarily. However, the committee has met, it has done work and here you will find it embodied in a series of questions. But like a great deal of work that is contained in a very small space, you will find that it does not show to any very great advantage. This schedule referred to here is for the purpose of obtaining data on the insulation of wires. There are ninety-nine questions in it. Gentlemen, I would say there were a hundred, but you know the old story. There are just ninety-nine questions and they will be all submitted to you in due time. I hope that you will all reply to them very carefully, so as to give us or our successors data to produce some valuable information for this association. These questions go to the very root of the life, use and advisability of employing conductors of all kinds. It is divided into various heads and if you will only each of you write a small book—because to answer these questions means to write a small book to this association—we will have a library of our own that will come out of the actual experience of the members of this association. None of the members of the committee have written papers on the subject. We have had several meetings. The questions are the result of conference on the subject. However, to-morrow, on the occasion of the underground discussion you will hear a very important paper read by the only member of the committee who did not feel himself justified in serving—that was Mr. Acheson of Pittsburgh. It was the only compliment he was able to return to the association for the honor they had done him in electing him a member of the committee, although he was an interested party. It was a high compliment and he shows his appreciation of it by reading a paper on the disruptive discharges in underground cables. It was hoped by the president in appointing this committee that each member would take a branch in a scientific direction in the solution of this question. Mr. Acheson has set a good example. I must admit that I tried to have the committee take that general direction, but seemed forced to it from want of leisure which brings many a man to do things that he would not otherwise do, because they were all disposed to write scientific articles, but they were compelled to embody as much as they could in these questions, throwing on you the onus of answering what you would answer.

That is the report I would offer for the chairman who is absent. He may come in the course of the day after I have received the brunt of all your criticisms. But I must say it is not my fault; I must say that in self-justification. So far as your position in this matter is concerned, all you have to do is to appoint another committee, if it is thought desirable to continue the subject, and step by step to gather such information as can be obtained by answering these questions. It will take a great deal of labor to collate the information which will be gained when this paper is distributed through the whole country. In closing what I have to say I would like to call attention to a fact that is told in a little anecdote by Benjamin Franklin. He once knew a very high churchman, and a very rabid one, in the town of Boston who had bought a cargo of Connecticut onions. He had put them in a storehouse, and the first thing he knew, they began to grow, very much to his mortification, and on a falling market for onions. He called in a friend and said: "Just look at those things. They remind me of those Presbyterians exactly; the more you damn 'em the more they grow." Now as to the excuses we make in this matter, the more we make them the more they grow. Take it for the best if we have not a very elaborate report to offer, it is because we haven't it to offer.

At the request of Mr. Morris of Nashville, Dr. Moses read the schedule submitted by the committee:

MR. MORRIS: A paper on the insulation of wires was one consideration which led me to come here, in order that I might learn something about that. My company has under consideration the re-insulating of its entire system and we do not know what is the best It seems to me that the solution of a good insulation is largely the solution of the underground question, and I must confess my very great disappointment with the report of the committee on that subject. I very much appreciate the delicacy the committee would have in reporting this wire or that wire, this manufacturer's wire or that manufacturer's wire; but at the same time it is a question that ought to be taken hold of and there ought to be some one to answer that question. I think if these questions were printed and sent out that the answers you would get would be so small in number that they would practically be of no benefit in arriving at any proper conclusion. I am satisfied that the managers of stations are not going to take the trouble to answer those questions and practically you will have accomplished nothing. We can only receive the report and discharge the committee and appoint a new one, or continue them. But I cannot refrain from expressing my disappointment in regard to that report.

DR. MOSES: There is a large steam hammer at Essen that strikes a hundred ton blow. It is about twenty feet high, but the foundations of that are two hundred feet under the ground. Now although this report here looks like a few lines there has been an immense amount of thought and discussion between us on the subject how to arrive at a solution of the question,—that is to make a report on insulation and installation that would be really of advantage to the National Electric Light association. I had in view this—perhaps in innocence, because all the gentlemen connected with wire interests expressed a great willingness to co-operate with me—I wanted to have specimens of every conductor that was in use laid before this committee and to have them make all the scientific tests and to supplement those with all the time and practical tests that they could devise. For that reason the president at that time selected a committee of gentlemen who had every facility in this country for doing the work. They were not prejudiced by association with any particular manufacturing interests, and each had a very excellent laboratory at his service. The Western Union was represented, the Bell Telephone company was represented on that committee, so to say—that is, their electricians were selected as proper persons. There were other companies represented and it was thought that the results that were going to be obtained could be made very valuable in that way. We had Cornell university present by its representative. They were all willing to do a certain amount of work, they said, but they were all determined that they did not want to appear to be advertising anybody's wire. As much as to say that if the sun shone to-day and they were to praise it, they were advertising the one who made it. It was true that that was all they were called upon to do—that, was to report on what was good wire. I tried to carry that through but they were all too modest and fearful of the results. They then tried to throw this matter back on the association and get what information they could right through them. The gentleman from Nashville may perhaps be mistaken in supposing that the superintendents of the different companies will be unwilling to furnish this information. I happened to be present last evening at a dinner given in honor of the executive committee of this association, for which I cannot express too frequent thanks, and there was one gentleman who is present now, I believe, who said, "I waive the executive committee part of it; I speak as the superintendent of a station." Another member of the executive committee spoke in the same way and then another, and it seemed to me that this association had tried rather to get superintendents of stations to represent them on the executive committee. Now that was a very healthful state of affairs, and why cannot we get from every man here who represents a company, some information that will be of value to this association? They are plain questions; all we want is that they should be truthfully answered, and the committee will winnow out all the chaff from it.

MR. MORRISON: It strikes me the original intention among the laymen was to find out from the scientists who are members of the association what is the best material and how it is best to apply that material to bring about the best condition of insulation for air lines mainly. I do not believe any steps have been taken in that direction by any of the committees that have been appointed. The list of questions which Dr. Moses has just read goes to show that they are on the hunt for the same kind of information that we are after. We sought to get the information from them; they are coming back now to get that information from the station superintendents. I do not believe you will get that information there. I do not believe that you will get a foundation that will go far enough into the earth to prevent jarring, if you seek to build your foundation in that direction. I do not believe that if the chairman of the committee on insulation were to press the case month by month during the recess between the meetings of the association, that he would get from the men, the use of whose laboratories we had in view when the committee was appointed, satisfactory data from practical experiments, from experiments made in lines which the superintendents of companies have not been able to reach, and such information as would put us on the right track in all future operations

The question of how to steer clear of insulated wire seems to be the one most largely in the minds of the men who own the stock in electric light companies. I beg to call the attention of the gentlemen here who belong to the various companies throughout the United States to this statement which I have just made, and to ask them if there are any here who fail to corroborate it. If the manager of an electric light company selects a first class insulated wire for his company the first question is, "What will it cost?" He will state to them that it will cost so much. Why, the answer is, 'There is Mr. DeCamp's company in Philadelphia, that buys wire for twenty-five cents a pound." The president, or one of the directors of your company will say, "Why can't you use exactly the same wire?" "Well, you can, but you wont have insulated wire; you will have underwriters' wire; you will have cotton insulation, which means no insulation." Now I claim that there are to-day half a dozen insulated wires which quite nearly fill the bill that we require. But the moment you suggest any one of those then there arises in the mind of every member of the association the fact that you are boosting one man's business at the expense of some other man's business. The next thing is that you are sat upon. One of the evils for which I have never been able to suggest a remedy, is just this. You want information. From whom can you get reliable information? From the man who has followed such a course of investigation as enables him to come with something in his hand and say, "Here is an article which will do so and so." That man is a wire man; he has produced some sort of an insulated wire and he makes a broad claim for that wire. Now it seems to me that if this committee were to take the wires offered by the gentlemen who claim such and such qualities of insulation and apply the apparatus and the facilities which their laboratories afford to the testing of that insulation and give a fearless and unbiased report, such an investigation I believe will very nearly carry out the idea which was in mind when this committee was first appointed. I throw out this suggestion for the chairman of the committe.

I am trying to get at the right thing, but I cannot get at it as directly as I could if it were another thing which I know more about. Have I impressed you clearly, gentlemen of the association? If I have not, perhaps if you will ask me a question or two on this line it will brighten up my recollection a little bit. Let me repeat what I said: If instead of the committee which has been appointed going to the superintendents of stations and asking them for the information which this association has sought; if they will take the facilities which they possess and will take the insulated wires for which such claims are being made and will make practical working tests of those wires and will give us the results it will be more satisfactory and more in the line of what was intended when the committee was appointed. There is some sort of a substance that is an insulator. There are a number of dielectrics. There are lines for arc lighting underground, and in operation. There are cable lines in the air where wires are all bunched together, insulated from each other, and they are in successful operation. Every one knows that incandescent light wire is under ground, and that a satisfactory insulation has been found for that. Now, then, among the multitude of able men who have turned their attention in this direction, backed up by enormous capital, why cannot we get at some of the practical results which they have achieved? Stop theorizing. Do not let us attempt to build up a theory, but let us get at the practical facts which these men have reached through this laborious and expensive method which we all know as the experimental line. It will bury more money than the yellow fever will bury corpses in forty years. I make this suggestion for the benefit of myself and the other gentlemen who desire to know what is best to do in the way of insulation. If Mr. Mason gets up—and I see he is moving in his chair—they will say that is simplex; if Mr. Candee gets up they will say that is okonite; if another gets up they will say that is kerite, and they will go through all the "ites" until your head swims, and you get no information. They will condemn this man and say he is getting up to advocate his own goods. I am not adverse to that myself, and I think the sooner you break down that idea and devote a part of your sessions to the purpose of getting information from the only source where you can get it—from the men and companies who have spent their money in this direction—until you abandon this fool notion that you are boosting one man at the expense of another, just so long you will be groping in the dark, and have such a report as that presented by the committee with blanks for some superintendent of an electric lighting station to fill in with information about something he knows nothing about.

MR. MASON: I do not propose to be held back from speaking on this motion by any fear that any one will say I tried to boom a wire. I do not believe that there is a representative of any company who would degrade himself and abuse the privileges of this floor by any such course, and I do not believe that anybody here will suspect me of any such intent. The president will remember that the original motion made two years ago for the appointment of a committee on insulation I had the honor to propose, and since that time I have felt moved to press the continuance of the committee or the appointment of new committees. So far the work has not been satisfactory, as the gentleman who presented this quasi report to-day has stated. The results have been *nil*. Personally I do not believe that all the laboratory experiments that these learned gentlemen and this committee could have made would have been worth one farthing to the members of this association. I do not believe that laboratory experiments upon insulation give us any reliable practical facts. Furthermore, in talking with gentlemen who are of very high standing as experimenters I learn that such is their opinion. They allow that they cannot make a series of experiments, one exactly duplicating another.

I think I may say that I fully agree with the gentleman from Nashville in his opinion that we should get but very few answers to those questions. If we sent the questions out, and if we got them, what is the value of each series of answers? First, it depends on the character of the man who writes, upon his ability, upon his frankness, upon many other factors, and the value of these factors cannot be estimated by the committee. I cannot conceive how we are going to reach the end we want through any such questions. I want to say right here and now that, anxious as I am for the facts that are aimed at by these questions, and earnestly desiring as I do that the whole electrical fraternity shall be acquainted with the facts regarding all insulations—among others, the fact that no one insulation is the best for all cases—yet, I do not believe it is a wise use to which this association may be put—to quote again the words of Mr. Morrison—to boom anybody's goods. I do not want the goods of which I have the honor to be the proprietor, to be boomed by this association. I do not believe any other gentleman here wants these goods to be boomed in that way. Mr. President, I shall run the risk of some unkind person saying, "He did not want his goods tested thus," and put myself on the good nature of my brethren by making this motion: That this report be accepted, and the committee discharged.

The motion was seconded.

THE PRESIDENT—The pending motion is an amendment offered by Mr. Mason, that the report be received and the committee discharged.

MR. MORRISON: I object to any such motion I object to the closing of any channel of information for this association. I do not think that the shutting off of any source of information that may have been opened in times past will be of benefit to the association. I am glad to receive information from Mr. Mason or from any other gentleman engaged in his line. We all know what an honest—I would say a modest—set of men the wire men are. I would never accuse them of being very honest, but modest. But for my own sake, and the sake of the other members of this association, I hope the gentleman's motion will not prevail. That committee is composed of the most intelligent men in the various lines of business which they follow. If you discharge them you are at the mercy of Mr. Mason and the wire men. If you continue the committee you have an intelligent body of reference to whom you can refer these matters, and if Mr. Mason comes to me and says, "I have the best insulated wire in the world," and gives me his samples, I can go to the committee and say, "Mr. Mason claims such and such properties for his goods," and then these despised laboratory experiments come in very well. You can take the results of the experiments to a chemist and he will tell you whether the constituent parts of the insulator are such as will carry out the guarantee of the gentlemen who offers the wire for sale. I ask that the gentlemen of this association will not vote to discharge that committee. It is a tough job to move to receive and approve a half-finished report like the ones the committee has sent in for two or three years, but it is better than no report at all. They may wake up to the fact that the information is of importance to them, and take enough time from their slumbers or pleasures to make up a report that is free from blanks and queries. I hope you will vote down the substitute and accept the report such as it is, because it is the best we can get at present.

THE PRESIDENT: The chair desires to state in all fairness that this question has been before the association several times, and at the Boston meeting the committee was continued upon the ground that sufficient money had not been provided by the association to make certain experiments in this direction, but they were instructed to collate information and make a report. Dr. Moses, for the chairman, stated that they had considerable valuable information. The point now is, if you adopt this amendment or substitute you will treat all that valuable information as practically of no use. It will be in nobody's hand except as an archive, and all the work that has been done will be lost. That is the way it presents itself to the chair. I simply state it so that you can vote intelligently. The question is on the motion to accept the report, and discharge the committee.

The motion was lost, and the original motion to accept the report and continue the committee was carried.

THE PRESIDENT: We will take up the paper of S. S. Leonard of Minneapolis, on petroleum as a fuel.

Allan V. Garratt read Mr. Leonard's paper on petroleum fuel, as follows:

PETROLEUM FUEL.

BY S. S. LEONARD.

The use of petroleum is by no means of recent date; it was known to the ancient Greeks and Romans, being used by them for illuminating purposes, as they had no electric lights in that day. In fact the word "petroleum" is of Latin derivation, meaning "rock oil." It has been, and is being used for various purposes, from the sure cure of numerous diseases to the generating of steam for electric light stations. It is found in many parts of the globe, although there are but few localities that are especially noted for its production. In our country, New York, Pennsylvania, Ohio and West Virginia produce the greater part of the supply. Although it was known to the early settlers of these states, very little importance was attached to its value. I presume there are none so young here but who will remember the oil craze, and the saying which was heard almost daily of "So and So" has struck "ile." Perhaps some of the members of this convention were fortunate enough to strike "ile" and possibly some were unfortunate enough to have been struck by "ile." But to return to our subject, petroleum fuel.

To say that it is a new fuel would hardly be correct, for petroleum has been used as a fuel for a number of years. Experiments to determine its practicability as a fuel have been creating a great deal of attention from those interested in the matter for the last twenty years, and is now occupying the minds of some of our ablest engineers and inventors. Quoting from a very able paper on this subject by Chas. E. Ashcroft, published in the *Rome Journal of Commerce*, May 26, 1888: "The calorific power of petroleum for the purpose of generating steam, and the evaporation of water is several times greater than that of ordinary coal. The successful use of oil as a fuel has, however, been of very recent date, yet so rapidly has it grown in favor that to-day it is regarded as a strong competitor of coal, for steam generating purposes, or where heat and fire are wanted."

It was with a great many knowing winks and nods of the heads of the engineers and firemen, who laughed at the idea of making steam by the use of oil, that the writer attempted the use of petroleum as a fuel. Of course it would not work, and it did not work. Why? Because those who were using it did not want it to, as they were afraid some one of them would lose his job. We had seen enough of its workings to satisfy ourselves that it could be made a success, and the result is, that to-day we are saving from 20 to 25 per cent. on the cost of fuel and 50 per cent. in labor, and these same men who laughed so hard on the start at our attempt to use oil would feel that this world was a poor place to live in, were we to return to the use of coal, for not only their hearts but their backs would certainly be broken.

Its advantages over other fuels are many. In the first place, it is much more easily handled; a steadier fire is easily maintained under the boilers, consequently the steam is kept at a more even pressure—a very important thing in the running of electric lights; there is no opening of furnace doors, allowing cold air to come in contact with the boilers, and there are no impurities in the oil such as abound in coal; when through with it, by a simple turn of the wrist, the fire is put out, and the ash pits are as clean as they were before the fire was started; in less time than it takes to tell it, you can start the fire. It is only rivaled in handling by natural gas, and even then, unless we have all the modern appliances for the handling of this gas, it is far easier to manipulate.

Permit me to describe the arrangements for the handling and use of this oil put in under the supervision of the writer. The oil is received in tank cars, holding from 90 to 150 barrels each, 42 gallons to the barrel. From these cars it is drawn off through a valve in the bottom of the car, to a storage tank or tanks,—there being two of them, holding about 320 barrels each. These are placed under ground so that the oil runs from the car into them by gravity. Care should be taken not to spill the oil, nor stir it up more than is possible as the odor from it is fully equal in strength to new mown hay, if not quite as agreeable. To prevent the stirring up of the oil, the supply pipes entering through the top of the tanks run nearly to the bottom, so that the tanks are practically filled from the bottom. In the top of each tank are manholes and a vent pipe, which is extended above the tanks a short distance. These tanks, which are boiler shaped, are placed end to end with a space of about eight feet between them; this gives room to get at the various pipes. They are joined together at the bottom by a pipe which also connects with the supply pipe running to the boiler room; then in the bottom of each is a drain pipe which will admit of cleaning them out whenever necessary. There is also a gauge glass in the end of each to show how much, if any, water is in them. There is also a gauge made by a copper float, which indicates the amount of oil in each tank. In cold weather a small steam coil is inserted in the tank car around the mouth of the valve to heat the oil so that it will flow readily, for when the thermometer gets in the vicinity of 30 or 40 degrees below, the oil is apt to be a little thick. Care should be taken not to heat the oil too much, for when hot it generates considerable gas which is not only very odorous, but is really the cream of the fuel. I think it an advantage to have the storage tanks under ground, there being less danger from them in case of fire, and during the winter the oil is less likely to chill. An open light should never be used near them, although the oil itself is really hard to ignite unless heated to a certain degree; still there is apt to be more or less gas around, which is quite explosive if brought in contact with fire. The supply pipes to the furnaces are provided with a valve where they enter each tank, also one in the fire room; this pipe of two and one-half inches diameter, is enlarged to six inches for about four feet, and in this six inch pipe a small steam pipe is inserted; with this, the oil is heated from 130 to 140 degrees. This lightens it so that it burns more readily, or I should say it is turned into gas.

We come now to the burners, which are also fed by gravity, as the storage tanks, although under ground, are still higher than the furnaces. One might suppose that owing to the recent introduction of petroleum as a fuel, some difficulty might be experienced in obtaining burners, but their name is legion, and they are as numerous as electric light systems, and like them in another respect, each man's is the best. Our experience has been that the more simple the burner the better the result. One that thoroughly vaporizes the oil before burning it is, we think, preferable to one that burns the oil. In the former there can possibly be no waste. In furnaces where we have been using this kind of a burner, the bricks are as clean as they were the day they were put in. Steam and hot air are the other ingredients that are used in connection with the oil, and an abundant supply of the latter we have found adds very much to the efficiency of the fire.

Regarding the proper settings, circumstances will determine to a certain extent. An excellent plan is given by the Standard Oil company, in their pamphlet on "Oil as a Fuel." This we have adopted with a few modifications which we found necessary by experience. There is no doubt but that a better fire can be obtained from oil than from coal or wood, and when properly used the smoke nuisance problem which has been agitating the minds of the people of some of our large cities is solved, for there is not a particle of smoke to be seen issuing from the stack—not even when everything is running full blast.

A word as to its danger. When properly put in and handled with ordinary care, or when good common sense is used in the use of this oil, I do not see why it should be any more apt to cause trouble than coal, although the insurance companies insist on higher rates when used. I think it more from ignorance of the subject than from there being any more danger. At the same time I am willing to admit that it could be put in and used in such a way as to greatly increase the danger of fire. So might your houses be wired for electric lights; piped for gas; a kerosene lamp hung, or your gasoline stove filled in such manner that the fire risk would be much greater than in the case of your neighbor who uses electric lights, gas, kerosene or gasoline the same as you do, but has his put in properly and handles it as it should be. As to its economy over coal, I have already mentioned that there was a saving of from 20 to 25 per cent. on the cost of fuel and from 40 to 50 per cent. in labor. From tests recently made by us, the following figures were obtained: 111.34 horse power running six hours, used 250 gallons of oil, costing $5.50, or at the rate of 70 cents per 100 horse power per hour; 104.8 horse power running six hours, used 3,461 pounds of coal, costing $5.45, or at the rate of 86 cents per hundred horse power per hour. Another test gave the following figures: 96.45 horse power running 8 hours, used 4,014.75 pounds of coal, costing $6.32, or 80 cents per 100 horse power per hour; 115.54 horse power running 7 hours, used 233 gallons of oil, costing $5.05, or 62 cents per 100 horse power per hour. On the foregoing basis, oil is from 17 to 32 per cent. cheaper than coal. The highest evaporation made with oil was 14.8 pounds of water per pound of oil, with feed water at 103 degrees, and with coal, 5.38 pounds of water per pound of coal, feed water at 103 degrees. The coal used was a good grade of Illinois lump, costing $3.15 per ton, but which is usually worth $3.25.

In the matter of labor, one man can easily attend from 7 to 10 150 horse power boilers and then have less to do than he would were he firing one boiler with coal. After a week's run with oil the boiler flues are much cleaner than they would be from the use of bituminous coal for one night, especially western coal. The fire room can be kept as clean as the dynamo room. There being no ashes, the expense of handling them is saved and the presence of dirt is avoided. The handling of ashes is no small item where some twenty tons of coal are being used every twenty-four hours. I might say that these tests were made during a part of a day's run, and it is our opinion that a more favorable showing could be made with the oil, where a larger number of boilers are in use. It seems to work better with a good fire than where a small fire is sufficient. With our pipe lines affording a cheap method of transportation, the future of petroleum fuel is assured, and I think there is no doubt but with true Yankee ingenuity a burner or some method will be brought forward by which the use of petroleum as a fuel will be greatly improved.

THE PRESIDENT: In connection with this paper I desire to read the following letter, as due to Mr. Leonard:

"MINNEAPOLIS, MINN., Aug. 22, 1888.

"*S. A. Duncan, Esq., Pittsburg, Pa.:*

"*My Dear Sir:* I herewith hand you the paper on fuel oil that you requested me to write when here. All I have to say is, that if you take the time to look it over and think after doing so that it is not worth the while to take up time that would undoubtedly be spent to better advantage by having it read before the convention, do not hesitate to lay it one side, as no feelings will be hurt. Should you, however, think best to present it to the convention, I shall feel very well pleased if I have been able to say anything that will be of any benefit to the association. It will be impossible for me to be present. Yours very truly,

"S. S. LEONARD."

The way this matter came about was that, being in Minneapolis some weeks ago, I walked into his station and wanted to know where he got natural gas, and laughingly he said, "We use gas in a different way." Then the question came up as to the economies and so on, and I found that he obtained such satisfactory results from the use of petroleum, and was so entirely satisfied with the economies as compared with his former experience with coal, that I asked him to prepare this paper. It is now before you for discussion, and I hope you will go into it.

MR. MORRISON: As Mr. Garratt was reading Mr. Leonard's article, I asked Mr. Pope to analyze the figures. Here they are: 250 gallons of oil cost $5.50; that is 76 cents per 100 horse power per hour. Coal costs 86 cents per 100 horse power per hour, a difference of 10 cents per 100 horse power per hour. If you take a station of 5,000 or 6,000 horse power and run a year, that is a considerable item. This paper is a very startling one to me. I saw it yesterday. It is a most startling one if the details are true. We have no reason to doubt the statements; I have none. If any gentleman has made experiments in that direction that will throw a doubt on these statements, I hope he will get up and say so. In 1865, that is twenty odd years ago, I was a telegraph operator at Parkersburg in West Virginia. They did not get coal enough for their use. There was a man named Shipley, who was engineer in the Swan house, a tavern right across from the telegraph office, and there for the first time I saw the burning of petroleum. There was plenty of it there then. Wood county had got into the habit of squirting oil out of the ground, as in Pennsylvania, and oil was very cheap. I think it is cheaper to-day than it was then. If this is true I want to know something about it, for we will be running six or seven thousand horse power within the next six months or so. There is another item not mentioned in the paper. With coal, it costs us 25 cents a load to haul the ashes away, I have not at the end of my tongue the figures of our station; but we use a low grade of fuel. It costs a little less than three dollars a ton. It is known as screenings and soft slack coal. It has always been an open question with me whether there was very much economy in the end with it, but it costs well up to three dollars before we get through with it. Now it costs you three men to handle it, and out of this trash that you burn, the ashes are nearly 50 per cent. of the fuel you put on the grate bars. Of course you must make allowance for these statements, because I am making them off hand. But I observe, if we burn, say fifty or sixty tons of coal a night, we generally have thirty or forty cartloads of ashes to haul away the next day. Now that goes to show that pretty near half of the stuff comes out in the form of ashes and sand and slate from the mines, and so on. That is another item that you can charge up to the economy of this petroleum fuel. In the new station we are going to build I shall equip one battery of boilers with coal oil. Mr. Weeks of Kansas City is going to make large additions to his plant, and I hope he will do exactly the same thing. What do you pay for coal in your country, Mr. Weeks?

MR. WEEKS: Two dollars and fifty-six cents.

MR. MORRISON: What kind of coal?

MR. WEEKS: Not bituminous.

MR. MORRISON: How much do you use per horse power per hour?

MR. WEEKS: About six pounds.

MR. MORRISON: On a Buckeye engine?

MR. WEEKS: No, Ide engines.

MR. MORRISON: I would suggest that every gentleman who is a member of this association, and who contemplates any additions to his plant, will take a copy of this report and analyze it carefully. If there is something he does not understand, let him ask Mr. Leonard to explain it and then try it practically himself?

FRANK RIOLON: I have been superintendent of a large coal tar company. From that material we got out various substances that were valuable for coloring matters. We finally came to the last portion of that which was known as dirt oil. It was used at that time for the making of glass, and was also sold later at a somewhat higher price for the creosoting of wood for railroad ties, spiles, etc. We at one

time found it impossible to get a sale for that article, and when we had to sell it for about a dollar a barrel, we found it cheaper to burn it, and we did burn it with very good satisfaction, although the apparatus for using it was very crude indeed, not only as to the economy of heat, but as to the wasting of fuel. We simply had a perforated plate and another plate that was not perforated underneath and let the oil drip down upon it; but we found it a very fine material to use. When we could not get a dollar a barrel for it, we found it cheaper than burning coke, for which we were then paying about $2.50 a chaldron.

MR. DECAMP: I would like to ask how long Mr. Leonard has been using oil?

THE PRESIDENT: The chair will state that he was there about the 10th of July, and Mr. Leonard had then been using that oil several months. He had first made the experiment with smaller quantities of oil, but the company had got to the point where he had put these tanks in as reservoirs, and they ran in a side track alongside his station and emptied into his reservoir tanks. It is as clean and nice a piece of business as I ever saw.

MR. DECAMP: Mr. Leonard's paper is a very remarkable one. Some two or three years ago I paid some considerable attention to the subject of oil fuel. Several methods have been adopted in Philadelphia for the utilization of oil, but the parties who adopted them finally abandoned them. I was never able to learn just what their reasons were, but they used them with apparent success for some time and, from what they said, with great economy, and then they dropped it. During a residence of two years in the oil region I found that the people there who we controlling wells and who had every facility for getting cheap oil from the various refineries through the country would prefer to pay as high as $20 a ton for coal. There would be occasionally a man who would start up with an oil-burning apparatus, but he would abandon it. Taking those things in connection with the inquiries in Philadelphia and the final results of their efforts there led me to abandon them. As I see figures are presented in that paper on the first cost of the fuel as compared with coal. There is not a very material difference, but the labor item and other expenses extended to coal, which would not be extended to this, are quite sufficient to make that of very great interest to this association. I have recently completed a test of coal. I have been using one particular coal for about four years, and we do not seem to have the benefit of the competition in the coal business. In fact, we do not seem to be able to strike coal that is equal to it; so we are confined to that particular coal. But the result of a recent test made with a new coal as compared with the coal we are now using showed a difference of 85 cents a ton. Our coal cost us in one instance 60 cents per hundred horse power per hour, and the other, 63 cents, the 63 cents being the lowest priced coal. Now we differ from Mr. Morrison; we do not use screenings. I have come to the conclusion, in the last two or three years, that the best coal was, taking all things into consideration, the cheapest coal to use. In the one case the cheaper coal gave about three cart loads of ashes—three and a half cart loads of ashes to every ton of coal, and in the better class of coal it was a trifle less than two. Our ashes cost us from one station 75 cents a load to haul and from another station 40 cents. There is a difference in our experience in using what we think is good clean coal. We have no refuse to contend with. In the comparison between these two coals on the point of labor I do not recollect just how many men there are in the boiler house, but it would have been necessary to have put one additional man in the boiler room from the fact that the better coal would run a full fourteen hours without the fire being cleaned, and with the other coal we would have to clean fires certainly during the run. That would necessitate another man as a laboring man in the fire room. I made up the estimate on those two coals. There is a difference of 85 cents a ton between them. The labor and everything else taken into consideration was equal to about $1.10 a ton. One coal cost us $2.90 put in the boiler room and the other cost us $2.75. Our consumption of coal is about 12,000 tons a year. The figures presented by Mr. Leonard are just about on a par with the best coal we use; so that there is no doubt of the importance of that paper if Mr. Leonard is correct in his figures.

MR. PERRY—The gentleman from Baltimore who is using coal dust and soft coal mixed, has had an experience in regard to the ash which is quite different from mine, although the net results of Mr. DeCamp's experiments and also the net results of the experiments of the gentleman from Baltimore were very similar, and they seem to be very much like the result of using the oil fuel; that is to say, about sixty-two one-hundredths of a cent to sixty-six one-hundredths of a cent per hour per horse power. That was the result of his experience, and also of Mr. DeCamp s. Last autumn our company having decided to build a station for themselves, being simply lessees of some property and having determined on some radical changes in the arrangement of the steam plant, I thought it would be an excellent thing to put on a first-class steam engineer and ascertain not what we might do by fancy firing and jockeying but just what we were doing in everyday practice. We selected for that purpose a gentleman very well-known who was trained under George H. Corliss, John T. Henthorn, a member of the American Society of Civil Engineers, and also of the Society of Steam Engineers and asked him to determine what we were doing. We made no changes whatever. The result was a horse power for about sixty-two one-hundredths of a cent per hour. We used for fuel three parts of anthracite dust—not pea and dust, but simply dust—no pea in it whatever—with one part of Pocahontas or an ordinary flattop coal. The result of that was about seventeen per cent. of ash. Our runs were good runs. We made forty-eight hour straight tests, running right through, two days and two nights. Having some power business, and also some all day business, we run our stations twenty-four hours. The result, which confirms the statement of Mr. Morrison, and also of that gentleman from Philadelphia, was about sixty-two to sixty-six one-hundredths of a cent per hour per horse power, and in the ash, as I say, about sixteen or seventeen per cent. in weight. Now another very peculiar thing was that when we just concluded our first day's run, it came on raining and continued to rain for the whole twenty-four hours. So far as we were able to ascertain there was not a change of a single light. The same hours were run, the same number of lights were run and everything, but it took an average of twenty horse power more, the average of the twenty-four hours being at the rate, I think, of about 142 horse power per hour for the twenty-four hours. The second day, when it was raining, and it did come down vigorously, it poured the whole twenty-four hours; it was just 162 horse power per hour for the twenty-four hours. We are using underwriters' wire all the way through. We have no especial interruption from grounds, except general leaks all along the line that might be induced. The results of coal using and of oil burning seem to be about the same in the four stations—the Baltimore, the Philadelphia, the Minneapolis and the Providence stations.

MR. MORRISON: I would rather take the gentleman's statement than my guesswork. The gentleman has stated these as actual facts from tests.

MR. PERRY: Yes. Our engines were indicated every twenty minutes.

MR. MORRISON: Now in regard to the ash.

MR. PERRY: As we intend to abandon the high pressure engine, for we propose to run at high speed the same as before, but we will use a compound engine and surface condenser, I wanted to know just what we were accomplishing with that engine, and to ascertain what benefit we would derive from adopting the other engine. We shall go into the new station in the course of three or four months. We have used an Armington & Sims engine. We have not yet fully decided what engine we are going to use except that it will be a compound engine and have a surface condenser. We intend to arrange the station so as to get a uniform load while operating the engine.

THE PRESIDENT: Did you include the cost of hauling refuse matter?

MR. PERRY: No, sir. That is simply the net cost of the whole.

THE PRESIDENT: Then you can figure twenty per cent. at least for that.

MR. PERRY: It costs us twenty-eight cents a load to haul the ashes.

PROF. VAN DER WEYDE: A year ago I had a rare opportunity to test the economy of coal compared with petroleum. I was testing a new style of dynamo in order to determine the economy of an alleged improvement. The parties interested in it concluded to make another test and by means of the power from a petroleum boiler. I was very glad of that. The petroleum boiler was furnished with a furnace. I had the consumption of petroleum watched carefully. I have not in my memory the correct figures, but I can tell you the upshot of the results obtained. The dynamo was tested also. The steam power furnished to it I had carefully tested with indicator diagrams. I made the test as well as a conscientious scientific application could make it. The result was that when compared with the consumption of coal, the petroleum was a great deal dearer notwithstanding that the coal is more expensive here in New York than in many other places. I remember the upshot only, which was this: As long as crude petroleum will cost more than forty cents a barrel it is cheaper to run under a slack coal. When I stated the result to a prominent Philadelphia manufacturer he told me that they had the free use of gasoline from some petroleum furnace there, and so they used it for a time until the gasoline got more valuable in the market, and they could not get it gratis any more, and they had to buy it. Then they stopped, because if they had to pay for the gasoline it would be much cheaper to use coal, and they returned to the use of coal. Only where the peculiar circumstances admit of getting petroleum cheap can it be used to advantage. If that is not the case, it cannot be used to advantage. For instance, in Russia they use petroleum largely because they have no coal, but in the city of New York I am perfectly satisfied that notwithstanding there is some saving in the handling of the fuel when we use petroleum, that coal is cheaper in New York city.

MR. MORRISON: What did you pay for the petroleum, Prof. Van der Weyde?

PROF. VAN DER WEYDE: The petroleum was $1 a barrel.

MR. MORRISON: I want to find out what this experiment is based on—the price per gallon for oil, and the price per ton per coal, the length of the test, etc.

THE PRESIDENT: Can you inform the association, Professor, the length of time of the test, and the cost of the fuel of each description.

PROF. VAN DER WEYDE: The test for petroleum was for about a fortnight.

MR. MORRISON: How large a plant?

PROF. VAN DER WEYDE: The plant was small. I must confess that the plant was not more than enough to furnish about twenty horse power.

MR. MORRISON: You used crude petroleum, I suppose?

PROF. VAN DER WEYDE: Crude petroleum.

MR. MORRISON: It cost you how much?

PROF. VAN DER WEYDE: A dollar a barrel. I made a calculation at that time that if we could have had the petroleum at forty cents a barrel, then it would be cheaper. I must also say that the arrangement for consuming the petroleum was very fine—one of the best I have seen, while the arrangement for the coal consumption may not have been so perfect. It was an ordinary horizontal boiler.

MR. MORRISON: What did you pay for the coal?

PROF. VAN DER WEYDE: I believe it was $3.50 a ton delivered at the place.

MR. WEEKS: What kind of coal?

PROF. VAN DER WEYDE: Anthracite coal.

MR. MORRISON: Do you think that experiment would be as reliable as using say 100 horse power?

PROF. VAN DER WEYDE: That is a question I would decline to answer. My experiments were with an engine of about twenty horse power.

MR. MORRISON: What was the difference in the cost?

PROF. VAN DER WEYDE: I have not the figures in my mind, but I know that the result of my calculation was that when we could get petroleum for forty cents a barrel then we could make steam as cheap as with coal.

MR. PENDLETON: In view of the discrepancy in the results, I thought it might be interesting, referring to Mr. DeCamp's experience to ask him whether he had ever heard of a petroleum fire burning the iron. I recollect many years ago that was the complaint of many engineers, and it might be interesting to know if he ever heard of such a result being caused by the discontinuance of the use of coal as a fuel.

PROF. VAN DER WEYDE: I am glad Mr. Pendleton mentioned this, because in my observation for fourteen days of a petroleum furnace I saw that it suffered greatly and I was expecting that if it was used for a protracted time it would give out.

THE PRESIDENT: Will Mr. DeCamp please answer the question of the gentleman?

MR. DE CAMP: I never was able to learn anything about that. The least and most important effort made in that direction was in a shoe factory. The proprietor of that factory is a man of very large means, and progressive; he had very small facilities for coal storage and went to a very considerable expense, I judged from the looks of his place, to put in the boilers and power suitable for his factory. I suppose, he used fifty horse power. I do not know whether he ever published them or not, but he made statements very freely that he was saving a great deal of money in his fuel account. I do not think he ran more than six months when he abandoned it. Whether he found his boilers were burning out or not I never heard. I sent our engineer over to West Philadelphia at one time to look at an experimental plant put up there, but there was nothing that he learned at all satisfactory to himself or me either. Petroleum has been a drug on the market for a good many years and at points where there is a great deal of power used, and it is a mystery how it can be very much cheaper. It seems to me that would have been discovered sooner, because in certain parts of this state there is great trouble in getting rid of a certain class of petroleum. This is a statement I heard made by one of the officers of the Atlantic Refining company. He made the proposition to me when we were hard pressed for steam at one of our stations. He offered to set up a locomotive boiler and put in oil to run it with, if we would assume the expense of putting it up. I figured over that for a while and came to the conclusion I did not want to do it. I said to him, "If this is what you state it is we will use it all over." We were then burning about twelve tons of coal a day at one of our stations where we had every facility for handling oil. He said No, that would not do. This Atlantic Refining company is a very large concern. He said that the product of oil which was adapted to that sort of firing was limited; that any demand for it for fuel purposes would put the price up so high as to make it prohibitory.

PROF. VAN DER WEYDE: Another illustration comes to my mind. In the city of Yonkers, at Hastings there are gas works where petroleum is converted into gas. They commenced with coal as fuel and after a while they tried petroleum, and instructed by the experience I had had before with a dynamo, I told them I did not expect they would be satisfied. It turned out that way. They abandoned the use of petroleum and returned to the use of coal.

THE PRESIDENT: The hour is getting very near adjournment and this is a very interesting subject. This question of burning out boilers with petroleum gas is all nonsense—because it is identically the same as natural gas when it is properly burned under boilers, and there are more boilers used with natural gas burning under them lasting longer than any with coal under them. In regard to the question of economy the only thing I know about it is the statement of Mr. Leonard. Mr. Leonard is a practical man and is running a good sized station and I have no doubt he will stand over the figures he has given. If these two points are such as to induce this association to have a committee to see if they can get a few more statistics on this thing, all right; but so far as the present discussion is concerned it will have to close at this time.

MR. MORRISON: I hope we may be able to hear from Mr. DeLand before adjourning.

MR. PENDLETON: I beg to say in reply to Mr. Duncan's remark that the action is different in burning gas under water and burning the petroleum in the manner spoken of by the gentleman who presented the paper. In one case you have the mixture of pure gas burning and in the other case you have a mixture of steam and hot air. It is a well known chemical fact that at white heat, usually steam is decomposed and the action upon the iron in the vicinity would be very different. I am aware that the use of petroleum for fuel is by no means a novel subject. I recollect in my boyhood that a locomotive boiler was put up in a battery and petroleum was used there for several days, being placed through roses in the fire box, and afterward when the question came up of burning the natural gas, it was sometime before they could manage to control it properly; but it became finally a great success. I only call attention to the fact that while the subject is worthy of the most careful attention of any committee, yet the burning of natural gas by no means solves the question of burning petroleum where hot steam and air are burned with it.

MR. SUNNY: The company that I am connected with has a station just south of the city limits of Chicago. Our coal cost us about $900 a month. We were burning it by the car load. The coal was wet at the mines; it was generally wet when it was weighed, and by the time the car got to us we found it short about twenty per cent. in weight, so we got about $700 worth of coal and paid $900 for it. On investigating this question of oil burning and corresponding with a large number of gentlemen who had some experience and who had been using oil burners for a long period, we found that in most instances the same results could be had out of two barrels of oil as out of a ton of ordinary bituminous coal. Our coal was costing us about $3.00 a ton. We could buy oil for sixty cents a barrel, so that

the equivalent of one ton of coal would be $1.80, making a saving of $1.20 on a ton of coal. The saving that we expected to get out on the change from coal to oil figured at the difference between $957 a month and $540 a month, and we make a saving of $45 a month for the salary of a coal passer, and $12 for hauling the coal in and taking care of the ashes. We expect to make in any event a saving of 35 per cent., although the figures guaranteed to us by the men who are handling oil burners, and the figures are said to be reliable by men who have experimented, would indicate that there would be a saving of 40 per cent.

With regard to Mr, Leonard's figures as to the economy, I should say that the fact ought to be taken into consideration, that the oil costs him, perhaps, two and a quarter cents a gallon in Minneapolis while it costs a cent and three-quarters in Chicago. With regard to the burning out of the boilers I found that that largely depended on whether you could distribute your flame all around the boiler. But there are several methods whereby you can distribute your flame so equally that there will be no effect on the boiler whatever and you can get the same result out of the use of oil as you can get from the use of coal with respect to the burning of boilers.

FRED. DE LAND: Mr. DeCamp asked how long the experiment at Minneapolis had been carried on—about nine months, if I remember rightly. They started the latter part of December or January. There is an experiment going on at New Orleans that will probably be interesting. It is the Louisiana Electric Light & Power company; Morris J. Hart is the general manager and he would probably give you all the information you desire if you correspond with him. I was down there several months ago. It is stated he has the largest station in the world in capacity. He has a capacity of nearly three thousand arc lights. The horse power, I believe, is over 1,200. He had been in the habit of purchasing his coal and having it shipped in barges down the Ohio and Mississippi River and wheeled in barrels 400 yards from the docks into his station. He found that by using oil he could save thirty-one per cent., and he brought that about in this way: He purchased his oil, of course, from the Standard Oil company. He sunk two large tanks in the ground, each containing 100,000 barrels of oil. The switch passes his station. The cars are brought down to the tanks emptied there and taken back. The saving came about in the wheeling out of the ashes; the cost of hauling the coal from the barges to the fire room; the doing away with one or more firemen and other little incidentals; but the net result at that time was a saving of thirty-one per cent. over the cost of burning coal.

MR. COLVIN of Baltimore: I was at that station a few days ago and the situation there is interesting. He has one battery of boilers running by petroleum and another running by coal right next to it. I could not give any technical data, but I could get it of Mr. Hart.

MR. DE LAND: I would like to say that the time I speak of was in March or April and they were then burning coal. Mr. Hart told me at that time that he was going to do away with the consumption of coal as soon as the question was definitely settled.

THE PRESIDENT: This is certainly an interesting discussion, but we will have to pass it and adjourn until to-morrow morning at such hour as will suit the convenience of the convention. Before doing so I desire to announce the committee on place of meeting, which will be as follows: Messrs. Brown of Chicago, Weeks of Kansas City; Officer of Council Bluffs; DeCamp of Philadelphia and Stanley of Bridgeport.

The first business to-morrow morning is the underground question and an exhibition, I understand, will be made for the information of the gentlemen of the convention.

On motion of Mr. Morrison the convention then adjourned until Thursday morning at 10 o'clock.

Thursday's Proceedings.

THE PRESIDENT: Gentlemen, this morning's session is to be devoted exclusively to the question of underground conduits or conductors in the city of New York We will have read all communications and clear up the general business on the secretary's table, after which we will take up S. S. Wheeler's paper, then the paper by E. G. Acheson, and then the one by H. C. Chenoweth.

The secretary then read the following communication from Somerville P. Tuck, Assistant Commissioner-General, addressed to S. A. Duncan, president of the National Electric Light Association.

"*Dear Sir:* I have taken the liberty to send you by mail this day a package of one hundred circulars relating to the Paris exposition of 1889. Mr. Abdank-Abakanowics, the representative of the syndicate which has contracted for the lighting of the exposition, is now in this city, having brought to this commission an official letter of introduction from M. Georges Berger, the director-general of the exposition. I inclose you a clipping from an electrical paper which will give you the details of his mission. I also inclose you blank form of application for subscription to the stock with extracts from the by-laws of the syndicate. At the request of Commissioner-General Franklin, Mr. Abdank cabled the president of the French syndicate on the 22d instant, asking if they would receive until Oct. 1, subscriptions to its stock on the part of American electrical companies, should such companies desire to subscribe, and in answer thereto a cable was received from the president to the effect that no engagements could be made as requested, but that the syndicate would do all in its power to receive subscriptions made previous to Oct. 1, next. Mr. Abdank informs me that he will await your convenience and be ready to make all explanations that may be desired in regard to the matter in which he is interested, and I am sure that he will receive a most cordial reception and due attention.

"Thanking you in advance for anything which you may be able to do for him."

THE PRESIDENT: This communication will be received and filed, and the gentlemen who desire to look into the matter will find blanks on the secretary's table, and I think, in view of the importance of the general exhibit which is to be made at that time, that we will all be interested in at least looking up the matter.

The secretary next read a communication from James Allison, president of the Centennial exposition of Cincinnati, addressed to Dr. Otto A. Moses, as follows:

"*Dear Sir:* The Commissioners of the Centennial exposition of the Ohio valley and Central States wish to call the attention of the members of your association to the electrical features of the exposition and to submit a brief statement of what is to be seen in that line, together with an invitation to all who can do so to visit us.

"It has been the intention of the commission to make electric lighting a special feature of the expoitions, and they have taken especial pains to have a variety of systems shown and to display the apparatus to the best advantage. As a large amount of light was required for illuminating the buildings, arrangements were made with five manufacturers of electric light machinery for the use of their apparatus, the exposition using the same for service and the companies having the advantage of large exhibits in regular service. The following companies are furnishing apparatus: The Westinghouse Electric company, Hartford, Conn., eight dynamos and 230 arc lamps; The Western Electric company, Chicago, Ill, eight dynamos and 225 lamps. The Mather Electric company, the Edison company and the Queen City company, of Cincinnati, two 500 light dynamos and 1,000 incandescent lamps each. Four of these plants are arranged in a combined station situated in the park building, each lamp driven by a separate engine, the whole making a fine exhibit, the other being located in the pioneer hall, on account of its being arranged for after the general plant had been designed.

"The lamps are distributed all through the buildings, being used for illumination and decoration, about 500 incandescents being used for the art gallery, about 600 for show cases, 900 for decorating music hall, 150 lamps for lighting the park building and the government exhibit; as many more for the machinery hall, and about 100 for the outdoor illuminations. This latter has been made a special feature, and shows the effect of tower and street lighting to perfection. Besides this there are several private exhibits of incandescent lights and some motor exhibits, among them a 50-horse power generator and about 25 small motors exhibited by the Queen City company. There is also an exhibit of constant current motors by the Card Motor company, of Cincinnati, O, the current being furnished by a Waterhouse dynamo, and two 2-horse power motors furnished by the Mather Electric company. In addition to this the commissioners arranged at great expense with the local Edison agents for a decorative and novelty display, which has proven a great attraction. About 2,000 incandescent lamps are used in designs such as illuminated fountains and cascades, umbrellas, Christmas trees, revolving flower gardens, etc, the lamps being flashed at intervals, giving a very fine effect. We hope the members of your association will find it convenient to come and see this display, and we think they will be well pleased."

THE PRESIDENT: The communication will be received and filed.

MR FOOTE: In behalf of that communication, I wish to say that the Centennial exposition in Cincinnati will probably show the best electrical exhibit ever seen in this country. We are to have a grand display, showing electricity in competition with gas, and I think it would be well for every member of the association to go to Cincinnati and see it. I would make the announcement, in behalf of the commissioners of the exposition, that the members of this association who will call at the secretary's office and present their cards of membership in this association will be given tickets of admission to the exposition.

The secretary next read a communication from W. H. Eckert, saying that the Metropolitan Telephone and Telegraph company had placed a telephone in the hotel for the use of the association

The secretary next read a communication from A. S. Hibbard, saying that the American Telephone and Telegraph company had placed a long distance telephone in the hotel for the use of the association.

Both communications were received, and a vote of thanks returned.

The secretary next read a communication from R. T. McDonald, treasurer of the Fort Wayne Jenney Electric Light company of Fort Wayne, Ind., and also a communication, attached to the former, from R. B. Rossington, local freight agent at Fort Wayne of the Pennsylvania company, as follows:

"*W. H. Harding, Secretary.*

"*Dear Sir:* Inclosed find copy of letter from R. B Rossington, freight agent at Fort Wayne, which will explain itself. We should be very glad, indeed, if you would take this matter up with the Traffic Association committee and see if the classification on carbons cannot be changed. As it is, the freight charges are exorbitant. Any assistance that we can render in this matter will be cheerfully furnished."

"*R. T. McDonald, Treasurer.*

"*Dear Sir:* Your letter of the 15th inst., relative to excessive rate on shipments of carbons from Pittsburgh, has been referred to Mr. Orr, division freight agent, Pittsburgh, Pa., who makes the following reply: 'Electric light carbons boxed are classified as first-class, at which shipment in question was billed. It would be necessary to have a change made in classification before we could do anything, and, besides, we have no complaint from shippers.' Judging from the above from J. P. Orr, I would think it advisable to take the matter up with shippers and have them petition the Central Association committee for a change in classification of carbons, as it is necessary that shippers, as well as consignees, shall make complaint of such matters, before they will be entertained by the company."

THE PRESIDENT: Gentlemen, you have heard the communication. It will be received and filed, and the chair would suggest that each member of this association engaged in the lighting business should file with the secretary a petition regarding the question of classification of freight rates for carbons. That being done, we will then take up the subject through the executive committee, and may possibly be able to obtain something that will benefit us all. There being no objection, that will be the action, and the communication will be referred to the executive committee. The secretary has already, under direction of the executive committee, sent out communications to the different companies, but has received very meager responses. Now, gentlemen, it remains with yourselves whether you will take this subject up and press it. The secretary can do nothing until he receives sufficient petitions to act upon. If gentlemen will promptly file petitions, or a statement of their views in regard to this matter with the secretary, the executive committee will at once attend to it.

The secretary next read a communication from Prof. Elihu Thomson, tendering his resignation as chairman of the committee on insulation and installation.

On motion, the chair was directed to appoint a substitute, the committee to select its own chairman.

MR. FOOTE: I ask permission to offer a resolution touching the address of Mayor Hewitt yesterday.

Permission was granted, and Mr. Foote offered the following:

"*Whereas,* Abram S Hewitt, mayor of New York City, has honored this association with an address of welcome; and

"*Whereas,* In his address he has given a concise and impressive presentation of the importance to civilization of the utilization of the electrical force in the mechanical service of the people, which is second to none ever before offered; and

"*Whereas,* In so doing he has announced sentiments indicative of the man in his complex character of philosopher, statesman, politician and master of business affairs; therefore,

"*Be it resolved,* That, as a mark of appreciation of his masterful grasp of the importance of the subject, his clear-sighted and generous presentation of it and his kindly courtesy, the secretary of this association be, and he is hereby, directed to print an authorized copy of said address in pamphlet form, and supply the same to members of the association at a price 10 per cent. in advance of the cost of production."

A MEMBER: I second that resolution.

DR. MOSES: I would respectfully suggest to the mover of the resolution that the question of cost of the pamphlet be entirely eliminated from it, and that instead of the publication of the address, since that address has been read by several millions of people this morning in the newspapers, there is no necessity for us to circulate it. It will become a part of the printed proceedings of our meeting any way. I would suggest, therefore, that the thanks of this association be tendered to the mayor simply.

MR. FOOTE: I wish to explain why I offer the resolution. I want to get the address in full, in an authorized shape, from this association for a use which, I think, will meet the approval of every person here. In Mr. Hewitt's remarks about the importance of the redistribution of power to the people he expressed identically the same sentiments that I heard expressed within the last four weeks by the president of the Commercial club of Cincinnati. About two weeks ago I was requested by an officer of one of the leading banks of Cincinnati to go with him to the exposition and show him the electrical exhibit there in its commercial relation. He brought with him an officer of the National Banking association. The National Banking association will hold its meeting in Cincinnati in October. The question to me was: Will the stocks of electric companies become dividend paying stocks? That is the point they are looking after. I wanted to get this paper in an authorized shape to distribute to the members of the National Banking association. I believe there are some 3,000 of them, and I am ready to give my personal order for 3,000 copies of the pamphlet if it is issued. I wish to say, also, that I would like to have the pamphlet prefaced by the address of our president in opening our sessions, showing the scope and the meaning and the importance of the electrical industry as it now stands.

MR. STEUART: I want to add myapproval to this resolution and my voice in favor of having the matter carried out to an execution I listened with the utmost pleasure to the address of Mr. Hewitt yesterday, and I am sure that I express the feeling of every member of this association when I say that it is the very best presentation of the importance of this subject, in which we are all interested, that has ever been made. It is the most practical, sensible and intelligent presentation of this very difficult and much mooted question of what is to be done with the electric light wires that has ever been put before us, or called to the attention of the public. I know that it is so in our own town, and I feel that it is equally the case in almost every town in which our delegates live; that the authorities are ignorantly striving to do just what Mayor Hewitt told us they had been striving to do in this town—trying to put the electric light wires underground without any knowledge whatever of the conditions necessary; and I think that the address of Mayor Hewitt, coming as it does from a man who stands prominently before the people of this country, not only as the mayor of the greatest city in the land, but also as one of the recognized leaders of the best and most intelligent thought among the people, will go far to quiet the difficulties that all of us have met with in the municipal bodies of our cities upon this subject. I therefore hope that the resolution will be adopted, and the address circulated as widely as possible.

MR. FOOTE'S resolution was adopted, but subsequently was reconsidered, and a motion of Dr. Moses to incorporate in the same pamphlet the address of President Duncan and Mayor Hewitt was carried.

MR STEUART offered a resolution that the chair appoint a committee of five to consider the recommendations of the president in his opening address, and report at this convention.

The motion was seconded by Dr. Moses, and carried.

Schuyler S. Wheeler of New York, then read the following paper:

Overhead and Underground Wires in New York.

BY DR. SCHUYLER S WHEELER.

It is my purpose, in as brief and concise manner as possible, to give you some idea of the condition of the overhead and underground wires in the city of New York, and the means which are being adopted by the public authorities to bring about a better state of affairs than the one now and for some time existing. In 1884 the legislature of the state of New York enacted a law to the effect that electrical companies in the cities of New York and Brooklyn should place their conductors underground. The local authorities were expected to enforce this law, and the maintenance of electrical conductors overhead in these two cities, after a certain day, was declared to be unlawful

Of course, the business of telephoning, telegraphing, and electric lighting could not be disposed of so summarily, and before the day appointed upon which the maintenance of wires overhead was to become unlawful fell due, the legislature enacted, in 1885, a law providing for the establishment and organization of a commission, the purpose and object of which were to provide a plan by which electrical conductors in the cities of New York and Brooklyn could be placed underground without interfering with the efficiency of the electrical service. By this law of 1885 it was provided that companies could submit to the commissions established in the twin cities plans for placing their conductors underground, and should the said plans meet the approval of the commissioners, the companies submitting them could thereupon proceed to place their conductors underground according to those approved methods. In 1885 the question of placing electrical conductors underground was very generally disputed, and no companies submitted plans to the commission within the required time. It thereupon became the duty of the commissioners of electrical subways to devise a method by which electrical conductors could be placed underground, and to compel companies to carry out the work according to this method.

The subject was then comparatively new, the difficulty not fairly comprehended, and the different kinds of service, as well as the ways in which the wires might be put under ground, were not even classified. The result of the investigation made by the commission to ascertain by what method wires could best be placed underground in cities, was that the commission had to listen to about four hundred and fifty plans, many of them having nothing to do with the work to be accomplished, and many of them utterly absurd.

Notwithstanding the impression that underground wires were a common thing in other cities, especially abroad, nothing had been done that would serve as experience for this city In many places wires had been laid underground singly, in pipes in sewers and in cables, but no such piecemeal plan could be allowed in a city having more telephones, more telegraphs, more electric lights and less available area than any other spot in the world, in proportion to the amount of business going on To be of any value, under such circumstances, a plan had to be found which would permit new wires being put in from time to time, almost without limit, without disturbing the pavements or streets, and of sufficient capacity to accommodate the large number of wires, for which a sufficient space under ground could scarcely be found between the various obstructions already buried.

The difficulty of the problem, and the reason why the experience of other places is of so little value to us, will be seen when it is considered that the number of wires in a given space in New York, taking the average, is very much greater than in any other center in the world.

The places between which these wires run, instead of being in an approximately circular area, as in the case of the three other leading electrical cities, are drawn out on a long and very narrow island, thus crowding the conductors together and increasing their length between two points. In addition to the difficulty of a much greater amount of wire and less area to contain it, there is the great difference of rapidity in business, which makes it necessary to be able to put up and remove wires and instruments here more speedily than in the older cities.

The ground was so filled with gas, water, and steam pipes, sewers, and pneumatic dispatch tubes, and their connecting boxes and manholes, that it was impossible to find a straight course for a conduit even of a small number of ducts; and the repairs to these, which are continually going on, would make the wires specially liable to disturbance and injury. The earth is saturated with gases from the various pipes, and this would collect in every open space, such as the subways would afford, destroying the insulation of the cables, suffocating the workmen, or causing explosions In comparing wires with gas mains, it is sometimes said that the former are much more difficult to bury successfully than the latter, because the leakage does serious harm, while the leakage from the gas pipes is of no consequence. It is true that the loss from escaping gas does not cripple the gas companies' business, at their present prices, but the gas fills the earth, gets into the electrical conduits, and there makes a very bad combination, for which electricity has to stand the whole blame. Indeed, if it were not for the gas the underground wire problem would be easier, and very much more agreeable. On the other hand, when the electric current wanders off and melts the iron of the gas pipe, electricity has to stand the blame, and thus there is not a fair distribution of the responsibility.

In order to treat the subject thoroughly, the Board of Electrical Subways of the city of New York investigated all the different systems in use in other cities, in connection with the many plans which were submitted for approval to be used in New York. It was found that, in Paris, they are fortunate in having extraordinarily large sewers, through which in the streets where the sewers run, all of the wires are laid, together with the gas and water pipes. These sewers have a large, arched passage, with a flat floor, through the center of which runs a deep trench or canal for the sewage. The flat pavement on either side of this forms a broad walk, over which the pipes and wires are suspended, from the arched roof on brackets. A rail is laid on either side of the canal, and on the track so formed a car can travel, carrying a drag, which is used in cleaning the canal or sewer proper. In the streets which do not have these sewers the wires are strung upon the housetops.

The only other place which at that time furnished experience at all applicable to the problem here, was London. But here there were and are now practically no arc lights at all, and therefore no circuits; there are extremely few incandescents, with no outdoor circuits; the telephone is not used very extensively, and the wires of the telegraph are placed underground by the government. The plan employed is what might be called the handhole drawing-in system, and consists of five inch cast iron pipes laid under the sidewalks, and accessible through handholes or "flush boxes." These pipes are said—I do not know how correctly—to be loosely jointed, for the purpose of admitting water to preserve the cables, which are of gutta percha, the same as is used for submarine cables, and which deteriorate very rapidly when exposed to the air. In other words, they have learned, by their experience with ocean cables, how to make insulation which will stand water, so they try to convert the subway problem into the same kind of work.

Conduits have been laid at a later date in other places. In Brooklyn there are about ten miles of Dorset conduit, and about four and a half miles of a conduit consisting of a wooden box made of creosoted boards loosely put together, with narrower ones slid into grooves on the inside, to form partitions. This duct, being loose and unstable, simply affords a means of keeping cables from touching each other, and keeping them in place; and as creosote will dissolve rubber, it is not a good place in which to put a rubber cable.

Another plan which has seen some slight use in Philadelphia is the Johnstone system. This consists of a broad, flat cast iron duct, made in sections about six feet long, and divided horizontally into an upper and a lower half or shell, so that a section can be removed and another substituted without cutting the wires already drawn into place. The duct is divided into a number of smaller ducts, for classifying the wires, by partitions consisting of long, thin slabs of cast iron, which are slid into place in grooves cast in the inside of the outer shell. The feature of this system is the facility which it affords of introducing an outlet from the duct exactly opposite any lamp post or desired part of a building, by taking off the upper or lower half of a single section, and putting in its place a new half-section with a hole in it at the desired point, to which a branching elbow can be bolted. This construction has been authorized for a distributing system in New York, on Broadway, from 14th to 34th street, for arc lighting, etc. The work is now being prepared, and the system is, therefore, of some interest.

There goes with this style of conduit a manhole formed of a bottom, a top, and a variable number of rings or sleeves placed one upon the other so as to build up the height of the manhole and to permit the ducts being run out at any depth to escape pipe obstructions, etc. One of these sleeves is split up into a number of panels bolted together, any one of which can be taken off to allow the ducts to be run out at either side at any angle.

All of the other plans by which wires have been put underground, except the Dorset and other manhole drawing-in systems used in this city, which will be described later, consist of nothing but the wire with covering buried in a trench, and are of no value beyond the taking care of their own particular wire.

Prominent among such plans may be mentioned the Edison tubes. This system, which has been extremely successful for its one kind of service, consists of heavy copper rods wound with rope and laid in wrought iron pipes filled with an insulating compound composed of Trinidad asphaltum, resin, paraffine and linseed oil. This compound is run into the pipes when heated to about 300 degrees Fahrenheit, under considerable pressure, while an exhaust is applied at the other end for the purpose of drawing out all air bubbles. The ends of the tubes are then plugged with wood soaked in paraffine, leaving the coppers projecting.

The chief peculiarity of this system of conductors, and the feature which is, perhaps, most familiar to all, is the means of connecting up these lengths of tubing and conductors. These rods are connected by short pieces of copper cable terminating in suitable copper sleeves, which are soldered to the ends of the rods when in position, and the bow-shaped expansion joint so formed is covered with hot compound poured into a small cast iron coupling box which is bolted to the junction. The lines terminate at the street crossings in large cast iron boxes, like manholes, where the rods are joined by heavy copper cables, to a suitable connecting device near the top.

This plan is too expensive except for very heavy conductors, but serves admirably the requirements of incandescent lighting. In the early days of the system the thin pipes were greatly damaged by picks in digging around them and by other outside disturbances. A slight blow from the pick would puncture the pipe, letting in a little water, which was liable in time to form an arc between the conductors, which would in turn burn the compound, converting it into a conductor and forming a ground. The greatest difficulty with these tubes was found to be that the insulation would be converted into carbon by the charring action of leaks, at the slightest start Tubes of the same styles as these, but containing a large cable of small wires, have been in successful use in carrying telephone wires out from the 21st street exchange in New York.

Another method, somewhat similar, is the Brooks system, which consists of wires covered with cotton and drawn through large iron pipes, which are afterward filled with a heavy resin oil, so as to prevent the water from entering, This oil is a good insulator.

The remaining plans are of the next lower grade of mechanical construction, and consist of wires and cables of various kinds laid in troughs and covered with some protective substance—usually tar or asphaltum Among these may be mentioned the few telephone and telegraph wires in Boston made into a cable and laid in a trough and covered with bitumen, a few telephone wires laid in New York, and the electric light wires in Pittsburgh, laid in the same way.

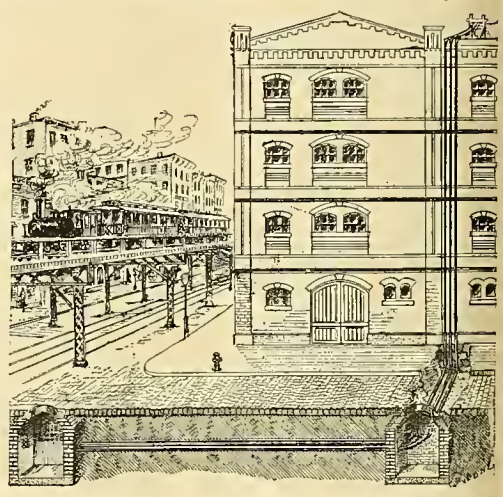
There are also innumerable places where cables of various kinds are laid directly in the earth, sometimes with board covering, to protect them from men with shovels. But none of these are of special interest to us, because, obviously, we cannot use them. The results of the investigations of the commission were summed up in their second report, dated the 30th of June, 1886, as follows:

"The principal systems of electrical subways may be divided—first, as to their material composition, and second, as to their mechanical construction, and the manner in which the wires are placed in them. As to the material composition, subways are: 1st, Of insulating material, such as wood, glass, concrete, etc., etc. 2d, Of conducting material, such as iron.

"As to mechanical construction, subways are, generally speaking: 1st, Tunnel systems; 2d, 'drawing-in' systems; 3d, solid systems; 4th, 'dropping-in' systems; 5th, combined systems.

"Tunnel systems, or those where space is provided underground sufficient to allow the passage to and fro of men who place the wires within the subway, could be recommended, were unlimited time and money at the disposal of the commission; but the expense of such a system and the crying need of immediate action, preclude the adoption of such a plan. If ever underground railroads become a feature of our city transportation, then, perhaps, the tunnel can be used for some of the future trunk line cables. In Paris, where the foundations of the city are honeycombed in all directions by large sewers, such a plan is practicable and admirable, but not to be thought of in New York.

"Drawing-in systems, or those where manholes are provided in the streets, connected by tubes or pipes through which the wires can be drawn, are next in prominence and convenience, to tunnel systems. In Chicago there were seen in successful operation nearly twenty miles of conduits of the 'drawing-in-and out' pattern of various materials, containing all kinds of wires, as follows: Eight



House-top Distribution Adopted by the Board of Electrical Control.

miles of the Dorset system of concrete conduit divided into ducts, and containing in the separate ducts wires of the city telephone, telegraph, and fire service, electric light wires, and wires of different telegraph companies. Four miles of the Johnstone system of iron conduit divided by metal shelves, and carrying the wires of the Postal Telegraph company. One mile of three inch iron pipes, four in number, carrying the wires of the Western Union Telegraph company. Three miles of iron pipes, carrying the wires of the Bankers & Merchants' Telegraph company. In Philadelphia a comprehensive 'draw-in' system of iron was seen, containing electric light and telephone and telegraph wires. In Boston some two miles of such 'drawing-in' iron systems are in operation In London 9,000 miles of wire are underground, bunched into cables and drawn into three-inch iron pipes.

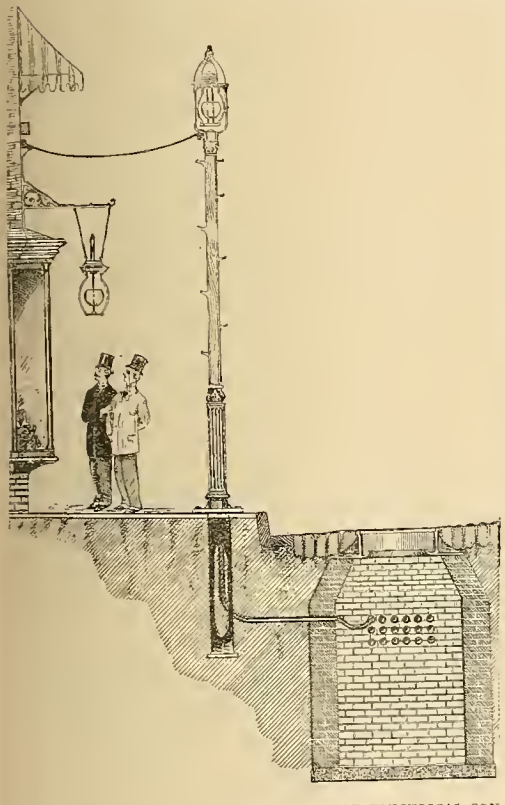
"Solid systems, or those where wires are permanently embedded in insulating material, and incapable of being reached except by tearing up the streets and the insulation, have been found to work with more or less success. The commissioners saw several miles of this conduit in successful operation in Chicago by the telephone company there, where the wires were buried in an asphalt or coal tar cement, laid in a wooden trough. Several miles of similar conduit are in use in Washington for electric lighting, and there are other instances of the successful operation of this description of conduit.

"In this city of New York there are several systems in use underground, each more or less satisfactory to those employing it. A prominent example is the Brooks system used by the Metropolitan Telephone & Telegraph company. It consists of an iron tube in which cotton wrapped wires are drawn, and the tube filled with oil, the oil acting as an insulating medium. It is kept at a desired pressure—the tubes constantly full—by means of a standpipe. They use a two and a half inch pipe, and the system is cheap, costing less than $11 per mile of wire, because into such a pipe they can draw 300 telephone wires. Wires for telephone purposes, and those used in the American district and other call boxes, are of very light intensity, and do not need as heavy insulation as do all other kinds. This system is claimed to give perfect satisfaction for telephone conductors.

"The Western Union Telegraph company has many

wires already down in this city laid in three-inch iron pipes, into which they draw cables manufactured from okonite or kerite insulation. These pipes are lead jointed, are laid in Broadway, and have manholes occasionally for taking out the wire. To sum up as to the form of the subway and the manner in which wires are to be placed in it, we are convinced that from the standpoint of an electrician simply it may be said that almost any plan or system can be made to work, from a single lead covered wire laid directly in the earth to a great tunnel upon whose walls the insulated conductors can be hung Within certain broad limits, any system is electrically practicable; retardation and induction can be overcome. It is only when we face in the city the mechanical, engineering, and chemical questions of interference with water pipes, gas pipes, and sewer pipes, of obstructions from vaults, of danger from steam pipes, of the action of sewer and illuminating gas, that the necessity for careful discrimination presents itself.

"In the future, when the uses of electricity become more general, and its nature better known, it may be that the city of New York will absolutely require a grand electrical underground highway, where space can be provided for the conducting and distributing of sufficient power to run all the engines and work all the machinery within the city limits. It may be, and probably will be, that before such a space is needed, much more will be known of the qualities of different forms of electrical conductors, and of the best methods of carrying them underground, and that the matter of electrical subways will be no longer experimental, but practically demonstrated in every detail. When such a time comes the commission or other such authority will determine what is required to meet the necessities of the occasion. The responsibilities of the present commission begin and end with providing for the requirements of their own day, and for such of the exigencies of the future as they can reasonably anticipate.



LAMP-POST ADOPTED BY THE BOARD OF ELECTRICAL CONTROL.

"Leaving out of consideration all tunnel systems as too expensive, we must also discard any system which calls for the simple laying of insulated cables in the earth. They would not stand the chemical action of the gases and acids; the streets would be continually torn up for new connections and repairs. We are thus shut up to the ways of electric subways or conduits, in which the wires or cables, insulated or otherwise, must be placed, and which once laid down should meet all the demands of the present and near future.

"Of conduits it may be safely predicted that, so far as the experience of this and other cities is a test, some form or the other of a 'drawing-in' system is most convenient. The life of the best cable is by no means satisfactory, and, of any particular cable, to predict how long it would last is purely speculative. Of wires not contained in cables it may be said that they are more uncertain in their length of life and usefulness. At all events for the purpose of distribution it is desirable that the wire should be easily approached at frequent intervals, and the commission cannot countenance any plan that looks to the disturbance of the pavement more than is absolutely necessary.

"It may be said that through lines of wires would be better protected laid in permanent beds of insulating material; but a 'drawing-in' conduit system allows space to be provided for new wires without the frequent tearing up of pavements. The commission can, therefore, give their approval to a 'drawing in' system with frequent manholes, as the general form of subway best adapted to meet the requirements of the electric service of the present."

Up to this time it was the general impression, which had not been contradicted by experience, because there was none, that the conduits must be built of a non-conducting substance and not of a metal, because the latter would be liable to chafe through the insulation on the wire and cause a ground, and because the companies using the more delicate currents—particularly the telephone company—declared positively that the presence of the large mass of surrounding metal would interfere by induction with the working of their wires.

The best known plan at this time for the building of ducts of insulating material, and without the use of metallic tubes, was the Dorset system, which has been laid to some extent in Chicago.

This consists of a bundle of parallel tubular ducts about two and a half inches in diameter, built of blocks formed of a combination of coal tar, pitch and fine gravel cast with tubular opening running through them from end to end These blocks were placed together, end to end, with the holes in line so as to form continuous tubes or passages, and were cemented together by pouring in mastic softer than was used in making the blocks, into the cracks between them The blocks were made to adhere to this by warming their ends with hot irons, and allowing them to cool after this hot mastic was poured in. To prevent the melted mastic from closing the ends of the passages, tubular pieces of metal or paper were inserted in the ducts at the ends of the blocks, making a sort of internal sleeve coupling. The conduits so formed terminate in brick manholes at the street crossings.

The objections to this material, as it was afterward found, are that it is brittle, porous, requires care in laying, and having no elasticity, cracks with changes of temperature, so that it is not likely to be made watertight with average workmanship.

But a conduit was accordingly laid in New York upon this plan on Sixth avenue from Twenty third to Fifty-eighth streets, a distance of 1.6 miles. And the objections were then found, as far as arc circuits were concerned, that its numerous joints were liable to open, and it might leak as mentioned above.

The next plan proposed for New York was to use a similar mixture without requiring it to be made so hard, with the object of preventing it cracking, and to preserve the openings or ducts by casting this bituminous mastic or mixture of bitumen and sand around long pasteboard tubes. But no tubes could be found which would not absorb moisture, and the heat of the mastic caused the ones tried to swell up and disintegrate. The manufacturers of indurated fiber wares were confident that satisfactory tubes could be produced, but it required special machinery and a long time for experiments. Tin and sheet iron linings were then suggested, but objected to, on account of the difficulty of making good joints. Zinc, however, was considered unobjectionable; and an experimental tube of the Averill system, consisting of soldered zinc tubes in bituminous mastic was laid in the yard of one of the manufacturers, but it was found that the heat of the mastic melted the solder of the tubes. This difficulty was met by substituting a lap or fold over seam, and then it was found that the heat of the mastic also affected the nature of the zinc, impairing its durability. On account of the certainty of the zinc tubing rusting and finally crumbling away it was next thought best to insure the permanence of the bore of the ducts by substituting for the soft mastic some substance which would set, after being poured in, and become hard and durable. For this purpose a hydraulic cement concrete filling was substituted for the mastic. And then a line was laid in Forty-eighth street. In laying, the thin zinc tubing was found very frail, liable to be dented in handling, and therefore undesirable. But the idea of the concrete was that it would maintain a hard, solid, smooth bore even after the thin sheet metal lining had rusted out.

After a thorough investigation and discussion of all the different materials, and the advantages and disadvantages of each, it was finally concluded that a conduit or subway for electrical conductors under ground is merely a mechanical protection for the wires to be placed therein, and should afford the very best protection possible to be procured, while the electrical protection or insulation may be safely left to the manufacturers of cables and wires to be placed in subways.

It was decided that the use of metallic tubes would not seriously interfere, by induction, with the working of the wires, and were to be preferred because the continuous conducting shield so formed will carry off any escaping current and prevent damage to other cables. Accordingly conduits of iron gas pipe embedded in concrete were put down, and these seem to be about the best kind so far constructed. They are best, first, because there are plenty of workmen who understand gas pipe fitting and laying concrete, and because they are durable and entirely non-combustible. The purpose of the cement is to prevent the iron from rusting, which it does very effectually. If in time the pipes are destroyed by rusting from the inside, the solid hydraulic cement concrete will remain, furnishing a permanent duct with a hard, smooth bore.

The manholes used in connection with these various kinds of ducts have nearly all been built of brick laid in hydraulic cement, and capped with an iron casting to form a seat for the watertight lid. The lids are usually bolted down upon a rubber gasket, but unlike the Edison manholes, instead of being held by a single thrusting screw which passes through a crossbar, presses down upon the center of the cover. Some of the lids have been made funnel shaped so as to cause water to drain away from the edge and collect in the center. By this means the liability to leakage at the gasket is diminished, because there is less chance of water standing over the joint. The facility of opening the manholes afforded by this method of fastening the lid with a single screw is of great value in reducing the labor and time required to open and close a line of conduit when laying a wire, and is a material advance in the solution of the problem.

In regard to moisture in the conduits. In the iron tube plan, which is the best, there is, of course, no leakage, because the tubes themselves are watertight, could even be made airtight, and because they are covered with cement, which is in itself watertight. The manholes are made of watertight materials, and there should be no leakage under the lid. Lookers-on find that a great many of the manholes have a great deal of water standing in them; this is simply because the lids are not fastened down, but simply laid in place by the builders, often without any gasket, and the manholes fill with rain and stay full until cleaned out for use. When cleaned and closed properly they appear not to receive any water by leakage. To satisfy myself of this I had an ordinary brick manhole which had been thoroughly cleaned and dried by letting the sun shine in, on a bright day, marked on the inside with lime all the way round under the cover, and then closed. This marking was to show whether any water came through the joint of the cover, in which case it would have run down over the lime mark and discolored it, or whether it soaked in through the bottom or sides. But after a rainfall sufficiently heavy to test the leakage, the hole was opened and found perfectly dry, and the lime undisturbed. This proved that there was neither leakage through the brickwork nor under the cover.

There is, however, another source of moisture which is hard to overcome, the condensation of vapor from the air which the manholes and ducts contain. Every time a hole is opened it refills itself with warm air, containing more moisture than it can keep when cooled down to the temperature of the masonry; consequently as soon as the lid is screwed down this fresh air deposits a dew on the inside of the manhole. As it is impossible to open and dry out a manhole without putting in new air, which will condense in turn, no amount of cleaning will overcome this difficulty. The presence of moisture tends to corrode exposed wires, and therefore the question whether it is better to protect the splices and make the insulation of the wires so that they will not be injured by this moisture, or to dry out the entire system of conduits by a system of ventilation, is unsettled. But this question, fortunately, is one of minor importance.

The question of distribution of electrical currents from the main subways constructed in the manner I have described has been largely left by the authorities in the city of New York to the preference of the electrical companies.

Two systems of distribution are at present actually in use in New York by the telephone company. They are known as the house-top system of distribution, an example of which may be seen at Sixth avenue and Fifty first street, and the hand-hole system of distribution, which may be seen at Broadway and Exchange place.

In addition to these systems, there are five modes of distribution which can be readily applied to the subways as constructed in New York, and which will be allowed in cases where they are severally most expedient, the lamp-post system of distribution, the house front system, the house vault system, now in use in Chicago, the back yard system, and the manhole system. In the heart of Chicago the distribution question is peculiarly easy of solution, because the sidewalks were left hollow by raising the street levels after the great fire, and the wires are run through these spaces to the houses.

Having decided the question of the kind of conduit to use, the commission proceeded to have subways constructed according to these plans. It was decided best, as a matter of expediency and to prevent accident, that electric light subways should be distinct from those intended for telephone and telegraph service, and it has, therefore, been the practice of the authorities in New York to build subways for one class of conductors upon one side of the street, and reserve the other side for those of other service.

The telephone people were the first to realize that underground wires were sure to be ultimately a success. Their business had grown enormously, they had reached about the capacity of their pole lines, and it was not easy to get the use of additional streets, because the streets were crowded with wires, both their own and those of other companies. It was found that the growth of the telephone business was practically put an end to by the fact that no more room could be found in which to string wires. House owners were charging a rental of one dollar per wire per year, which, in some cases, amounted to a very large rental in the case of building, and the telephone people had reached the point of refusing subscribers. They came forward, and were the first to declare for underground wires.

After some resistance, the telegraph and electric light companies have come to the conclusion that it is as well for them to comply with the demands of the public, and place the bulk of their conductors underground. And, as a matter of fact, in the city of New York to-day there is but one single company out of the large number doing business here which refuses absolutely to comply with the provisions of the subway acts, and nine-tenths of the opposition and outcry has been caused by this company.

At the present time the total construction of single duct in the city of New York amounts to 420 miles. In these subways there are already in operation some 4,000 miles of telephone and telegraph wires, and some hundreds of miles of incandescent electric light conductors. Cables for arc lighting are to be drawn in on Broadway from Fourteenth to Thirty fourth streets by the Brush Electric Illuminating company within the present week. A letter from the electrician of the Metropolitan Telephone and Telegraph company, bearing date Aug. 25, as estimating the exact lengths of cables of various kinds now underground, is as follows:

NEW YORK, Aug 25, 1888.

S. S. Wheeler, Esq., Electrician of the Board of Electrical Control.

Dear Sir: I have hastily collected the following information relating to the underground mileage of wire.

The number of miles of single wire conductors in New York city of the various kinds is as follows:

Brooks system, laid May 28, 1885	200 miles
Patterson cable, laid March 18, 1885	226 "
Edison system, laid June 20, 1885	194 "
Patterson cable, laid in 1886–87	805 "
Patterson cable, twisted in pairs, number of miles, counting both wires, in 1888	2,272 "

We have in course of construction some 12,000 miles of conductors which will be laid in September and October.

Total number of miles already laid in New York	3,697
The number of miles of underground wire in Brooklyn	2,100
The number of miles of underground wires in Paris.	4,100
The number of miles of underground wires in Chicago	200

As per report of telephone convention held Sept. 26, 1887:

The number of miles of underground wire in Boston	400
The number of miles of underground wire in Pittsburgh is about.	1,000

I find that there is a very small amount of underground wires used in London for telephone purposes, there being some short lengths used entering exchanges, which are not worth while considering Respectfully,

J. A. SEELEY, Electrician.

It will be seen from this that there are already underground in the city of New York more electrical conductors than in any other city in the world, while the capacity of the construction already finished in this city may be estimated fairly at something over 30,000 miles of conductors.

There are through lines completed from the Battery to the Park, on the two principal thoroughfares of this city, Broadway and Sixth avenue, and a gradual conversion of overhead system to underground ones in the busy parts of the city, may be confidently expected

The Board of Electrical Control is not unmindful, however, of the magnitude of the labor and expense required in converting the present arrangements into underground systems, and does not contemplate either the hampering of the business of electrical companies by forcing unreasonable numbers of wires underground, or by attempting to compel the use of subways faster than is consistent with the efficient use of the different electric service by the public. If the great mass of overhead conductors are removed and the remainder of the service brought to a condition which will insure the safety of the public and at the same time, the welfare of the companies themselves, it will be the result desired by the people of the city, and which the Board of Electrical Control is endeavoring to attain

As to this matter of regulating the overhead service in the city, I may say that an investigation of all the wires overhead, instituted since I have been connected with the work of the authorities in charge of electrical matters here. by the inspectors appointed after a rigid examination, and found competent for the purpose, has shown that a great deal of very bad and unnecessarily dangerous work has been done in New York, and that a reprehensible and inexcusable condition of overhead wires is the principal, if not the only, cause of the clamor for underground service.

In addition to this, an enormous quantity of wire and a large number of poles, not in use at all, exist, amounting, as has been variously estimated, to from a half to two-thirds of all the wire and poles in the city.

As I have said, a system of inspection and reports has been organized, and within a few months there have been found and reported to the owners 2,000 dead wires and other objectionable things described in the inclosed schedule, which explains itself. A notice is sent out in every case; at the end of a week the work is again inspected, and if nothing has been done the owner is again notified, and if the wires, poles, etc , are not necessary, a notice is also sent to the Bureau of Encumbrances of the Department of Public Works to remove them.

All arc lamps that are so low as to be within the road of pedestrians with an umbrella, are reported as too low. Circuits which have especially defective insulation or joints are reported as dangerous. A few cases of bad indoor work have been reported as violating the rules of the Board of Fire Underwriters, and so on. The number of complaints sent to the various companies as well as the proportion of them that receive attention by each company, are shown in the detailed schedule, which indicates the position taken toward the work of inspection by the several companies, and I may say that the single opposition company, of which I have already spoken, is the only one which disregards the notification of flagrant bad work, for which there is no excuse, and which every one else admits should be inspected on behalf of the public, and corrected immediately.

One has no idea of the aerial freebooting that is and always has been going on with overhead wires, until they spend some time seeing what there is overhead. The condition of wires in this city is simply outrageous. Every other kind of business, such as those which involve obstructing the sidewalks, has fallen under the supervision of some branch of the government, and cleanliness and order have been insisted upon, but heretofore there had never been any supervision of out of door wiring, and its condition corresponds to that of a city without police supervision.

The companies owning wires will not permit each other to make common use of the poles, but will chop off wires owned by others without notice. The telephone people object to the electric light wires on account of the induction. Where there is a line of light wires on their side of the street passing close to their poles, they will not allow them to be made fast. The result of the necessity thus made for extra poles is sometimes four lines of poles on one side of the street, hence most of the wires swing close to or against the other poles to which they are not attached, and linemen in climbing them have to crawl through all the other wires which are not fastened to cross arms.

Among the causes of dangerous wires and unnecessary obstruction found by the inspectors are full lines of large poles, extending over miles of streets, filled with wires which are "open" and out of use, but left standing to save the expense of removal. Long lines of poles left standing to preserve right of way, arc light day circuits, within reach and with the insulation dropping off, and bunches of dead wires hanging from housetops, etc

All of the work of inspection done by this department is such as is necessary for improving the condition of overhead electrical work and removing fixtures, etc., that are absolutely dangerous and objectionable

For the purpose of the various legal proceedings which are being carried on to compel the most objectionable arc light company to make a start in placing their wires underground, the other principal companies have proceeded voluntarily: The pole line on Twenty-fifth street from Broadway to Fifth avenue was chosen for special complaint The subways on this route, which were specially provided for these lines, have been finished for some time, and are dry and in good order

This line of overhead wires is in bad order, one of its stretches having no less than thirteen splices, and it is made still more liable to do damage by the presence of numerous dead wires, which not being required for use, are practically stored upon the cross arms.

In conclusion we may sum up the situation about as follows: The telegraph and telephone problem is practically solved It is found necessary to resort to subways in order to get sufficient space for wires, and wires for this use are being drawn into the tubes as fast as the labor can be performed. There about 4,000 miles of telephone and telegraph wire already underground, and 12,000 miles of cables about to be laid in the fall. It is estimated that the saving in cost of maintenance will be about $100,000 per year, owing to the permanence of the style of work which is possible underground.

The laying of electric light wires has not been so fully developed, and naturally none of the companies care to bear the expense of the first experiment. But after the initiative has been taken, the difficulties will be overcome as they arise, as in the development of all other enterprises, and the undergrounding will become a settled and accepted fact

Meanwhile the lawless running of overhead wires is being stopped. All wires in a street must be run on a single line of poles. Here and elsewhere the dead wires and poles must not be stored in the streets, and all construction must be made under the supervision and control of some official in precisely the same way that other works which affect the public are carried on.

THE PRESIDENT: If any one wishes to ask Mr. Wheeler questions on the subject he has discussed in his paper, it might be well to put those questions now, before they slip from mind.

MR. LYNCH: I would like to ask Mr. Wheeler the estimated cost of laying those conduits?

MR. WHEELER: I am not very well prepared to give the cost, but if Mr Leslie, the manager of the construction company, who is present, will do so, I think he can probably answer Mr. Lynch's inquiry.

THE PRESIDENT: Mr. Leslie can you answer the question?

MR LESLIE: I do not think it would be possible to give an intelligent reply to that question, because the cost of construction varies very much as the circumstances vary. In some cases the engineering difficulties are easily overcome, while in other cases they are very difficult indeed. Then, again, the character of the excavation has a great deal to do with it It is hard matter to say what the cost would be unless the number of conduits and side conduits, and so on, are specified.

MR DE CAMP: I would like to understand exactly what Mr. Lynch's question was I didn't quite catch it.

MR LYNCH: My question referred to the cost of the conduits laid in the streets of New York, with a manhole at each block.

MR. DE CAMP: Do I understand that all this great work has been going on here in New York without anybody understanding what it is going to cost?

MR VAN DER WEYDE: I suppose it would be necessary to know the circumstances of each case first, in order to tell what the cost would be. I have noticed that the difficulties are very great in some places. But where it is all plain work, with no great engineering difficulties to overcome, it would be interesting to know what the expense is

THE PRESIDENT: Gentlemen, this is getting into the discussion which is to be had later The design of the chair was to afford an opportunity to gentlemen to put questions to Mr. Wheeler about matters which they might forget by and by, and could not carry over to the general discussion.

MR MORRIS: Mr. Wheeler spoke of there being 9,000 miles of underground wires in the city of London. I would like to ask him whether those are high tension wires, and, also, what is the efficiency of the service?

MR. WHEELER: I stated in the paper that there were practically no high tension currents in London, and that the wires put underground were put there by the government.

MR. LYNCH: Mr. Wheeler stated also, that there was a conduit in Twenty-fifth street I would like to know if any means have been devised for getting the wires from the poles into the conduits, or whether any supplementary conduits have been provided by which the wires could be run to customers living in the block?

MR. WHEELER: I also stated that the Johnstone company's conduits had been authorized as a distributing system to be laid on Broadway, and that it could be used in Twenty-fifth street, but that the choice of a distributing system was left to the company, and if they could find a better system, why, of course, they could use it It does not seem to me very difficult to get wires from a manhole to a pole. There are several hundred telephone wires at the corner of Twenty-third street and Broadway, coming up in tubes from the manhole, and going out on the poles. The same thing exactly can be done with the electric light wires. The question that is most difficult to answer is, how to distribute them cheaply to each house, not how to get them to a manhole.

MR LYNCH: Can the gentleman tell me if any practical trial has ever been made of the Johnstone system for electric lighting wires?

MR WHEELER: I am not informed as to that. I understood Mr. Johnstone was to be here himself.

MR. DE CAMP: I will say, in regard to the Johnstone conduit, I presume it is the same as that used in Philadelphia—that it is a very good form of conduit It is expensive. but I believe it perhaps the best conduit we have I am free to say, at any rate, that it is the best form of conduit that has ever been brought to my attention; but we have never got anything to put into it yet that answers the purpose.

MR. LYNCH: As I understand it, the Subway company which lays down the conduit charges a rental for its use, and the company whose wires are to be put into it are supposed to make an arrangement with the Subway company to put down supplemental conduits and connect the wires therein. I want to find out if the electric light companies are directly responsible for the wires and the supplementary conduits.

MR. WHEELER: I think that question had better be referred to Mr. Leslie, who represents the Conduit company.

MR. LESLIE: I do not see wherein the question of responsibility is important in the question of the practicability of operating electric light current. I will say that the company that Mr. Lynch represents has been furnished with information on all those points.

MR. LYNCH: I do not appear here as representing any company. My connection with the Illuminating company was broken off some time ago. I appear here asking for information as a member of this association. As I understand it, the subway commissioners say: Here is a system which we think the electric light companies should put down and should be responsible for, besides paying for it.

MR. LESLIE: I believe Mr. Wheeler represents the subway commissioners. You had better ask him that question. [Laughter.]

THE PRESIDENT: Gentlemen, this is getting off the main point, and we are getting into the general topic. The chair will have to stop this discussion at this point and ask the gentlemen to be present this afternoon, because it is very evident there are going to be several questions that will have to be answered.

We will now take up the next paper, which is on the subject of disruptive discharges in underground cables, by E. G Acheson.

DISRUPTIVE DISCHARGES AND THEIR RELATIONS TO UNDERGROUND CABLES.

BY E. G. ACHESON.

From among the numerous problems earnestly calling for resolutions before perfection can be claimed in underground systems of electrical distribution for arc lighting, I selected as the one presenting probably the greatest importance, and consequently, the one most desirable to solve: The determination of the cause and cure of the frequent puncturing of the insulation, especially at the terminals of lead-encased conductors when carrying high potential currents.

In a communication to the electrical press, published July 7, 1888, under the title, "The influence of the condenser on disruptive discharges," a detailed description of a series of experiments on the discharge between points in air was given, they having been made with varying e. m. f's, and condenser capacities. These experiments resulted in the formulation of the general law expressed in the equation:

$$\frac{(E.\ m.\ f.)^2 charge\ in\ coulombs}{a} = d$$

or

$$\frac{(E.\ m.\ f.)^2 capacity}{a} = d$$

where a is a constant for the dielectric and d is the spark length; the charge being expressed in coulombs and the capacity in farads. In the same article the value of a was taken as 135 and d was expressed in inches.

While these experiments may serve as a basis or foundation to build upon, much more must be known before they will meet the requirements of the engineer operating with high potential currents, and with the object in view of obtaining at least a small portion of this required information, my experiments were extended into the more practical part of the subject, and furnished the results I have embodied in this paper.

The most probable condition of a discharge in a cable would be between the cylindrical conductor and a point or projection on the lead covering: hence the first point to determine was the striking distance between such a cylindrical body and a projection or point. Experiments were made with a point and the side of a wire, two sizes of the latter being used, a number 8 and a number 16 B. & S. wire gauge. There was no difference between the results obtained with the two sizes. The length of the spark was found to be about 55 per cent. when compared with that produced between points with the same e. m. f. and capacity. This difference gives a new value for the constant a, which is found to be 263. The equation for the spark length between a point and a cylinder will therefore be—

$$\frac{(E.\ m.\ f.)^2\ capacity}{263} = d\ in\ inches.$$

The following approximate values of a have been determined, for the conditions and dielectric specified, d being expressed in inches:

DIELECTRIC.	SPARKS BETWEEN.	a
Air	Points	135
Air	Points and wire	263
Paraffine and cotton	Point and wire	5,822
Ozite and cotton	Point and wire	7,759

The conditions governing the possible disruptive discharge, through the insulation of the lead-covered, grounded cable, are so numerous that it would be quite impossible to exhaustively consider them, even if the necessary data were at hand. It will, therefore, be necessary to confine the subject to the more important conditions and the exposition of the law by means of a case that might be found in practical work.

In Fig. 1 is illustrated a portion of an arc light circuit, consisting of the dynamo D and thirty lamps L, connected in series by lead-covered underground cable. For the purpose of illustration and calculation, it is assumed that the lamps are separated a uniform distance of 300 feet; the size of the conductor a No. 4 B. & S. wire gauge, insulated with one-tenth of an inch of cotton and paraffine; the capacity per mile is .704 of a microfarad, and the e. m. f. at the brushes of the dynamo 1,500 volts; also as an assistance in calculation, it is supposed that the drop in the e. m. f. occurs in the lamps only. The capacity of each one of the thirty-one sections of cable separating the lamps and

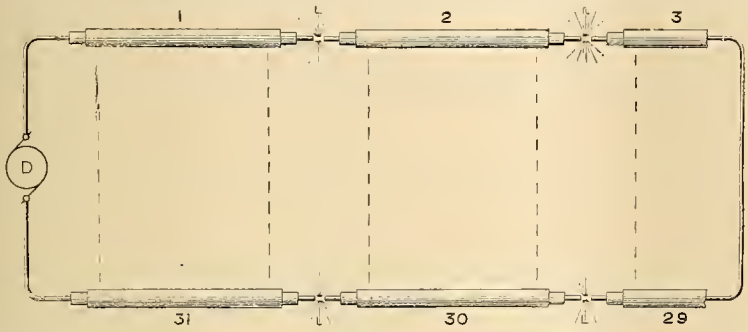


FIGURE 1

dynamo, and which are numbered in regular order from 1 to 31 will be .04 of a microfarad, and the capacity of each division, from conductor to conductor across the circuit, as between sections 2–30, will be—

$$\frac{.04 \times .04}{.04 + .04} = .2 \text{ microfarad.}$$

or in this case one-half that of one side.

With these conditions, each division composed of the paired sections as 1–31, 2–30, 3–29, and so on, will have a potential tending to break through the insulation of the lead and thence across the intervening medium in the direction of the broken lines, of a value of 1500 volts at 1–31, and decreasing by 100 volts for each succeeding division. These various potentials will, provided the insulation is perfect and the leads well grounded, induce a static charge between the conductor and the lead of each section, of a value measured by the potential across the division, and the specific inductive capacity and thickness of the insulating material.

In the case under consideration, the thickness of the insulation and the specific inductive capacity are such as to induce a condenser capacity of .02 of a microfarad, and with an e. m. f. of 1,400 volts as would exist between 2–30, the discharge would be, 1400 x .02 microfarads .000,028 of a coulomb, and if the conductors forming the two sides of this division, should, while in this charged state, be insulated from each other, as might be done by breaking the electrical continuity at both ends of either one of the sides, the energy stored within it would be able to produce a disruptive charge through air, from the conductors to a point or *vice versa* equal to

$$\frac{(1400)^2 .000028}{263} = .2087 \text{ inch.}$$

This is almost two and a tenth times the thickness of the insulation but the thickness of cotton and paraffine, composing the insulation of the cable that this energy would pierce, would be—

$$\frac{(1400)^2 .000028}{5822.} = .0094 \text{ inch.}$$

or less than one-tenth of the thickness of the insulation.

Two questions now present themselves: First, are the sides of division 2–30, or any of the others, liable to become insulated from each other, or attain a condition favorable for a discharge, for will there not always be a path open for discharge around the circuit, either by way of the lamps or the dynamo?

The second question may be stated thus: Is it probable, with the conditions of the case above taken, that the insulation will ever be pierced, seeing that the discharge through the insulating medium cannot be greater than .0094 of an inch, whereas the thickness of the insulation is .1 of an inch?

It is evident that from accidental causes, such as the breaking of the circuit at two points, it is possible to have the two sides of the division, insulated from each other: but such accidents are not liable to occur, especially when it is remembered that the breaks would have to be made simultaneously. To make the probability of this action occurring worthy of consideration, other means of producing it must be looked for and found.

On a circuit using coils shunted around the arc, the electrical continuity is established at each end of the two sides of the division, by one of these coils and the arc. From the experiments of various experimenters, prominent among whom may be mentioned Prof. Hughes and Dr. Oliver Lodge, it is concluded that the self-induction in these coils would be of such a value as to offer an almost insurmountable barrier to the flow of the charge through them; and this being the case, the discharge, if it occurs at all, must be through either the arc or the insulation of the cable. To determine whether the charge would pass off through the arc, the apparatus shown in Fig. 2 was used. Twenty incandescent lamps L, L, of 100 volts each, were connected in series to the lines M, N; in the line N was placed the switch S, and the contact points 1 and 2, the former being mounted in the revolving post P, thereby permitting of the points being opened; the condenser K was connected across the circuit from the line M at a point 3 between the switch and the contact points on the line N; around the condenser were placed the points 4 and 5 with suitable means of regulating the distance between them. M and N were connected to the two sides of a transformer supplying an e. m. f. of 2067 volts. The points 1 and 2 being in contact, no amount of rupturing of the circuit at S and adjusting of the space separating 4 and 5, would cause a discharge to occur between them; but upon opening the points 1 and 2, and thus establishing an arc in the circuit, the opening of the switch S would cause a heavy discharge between 4 and 5. From this experiment and Dr. Lodge's results with circuits containing self-induction, the conclusion must be drawn, that conditions favorable to a disruptive discharge are exceedingly likely to occur; that upon opening an arc light circuit the various sections of the cable become, so far as the static charge is concerned, insulated from each other.

In considering the second question the fact is at once recognized, that where the constant a for the dielectric surrounding the conductor is that of the cotton and the paraffine, a disruptive discharge would, under the circumstances cited, be impossible; and the answering of the question in the affirmative will therefore turn upon the probable lowering of the value of a.

Any one familiar with insulations as applied to conductors, knows that all of them, with the exception of rubber and gutta percha and their compounds, will permit water or moisture to penetrate them, and as the hydrocarbons and water do not form chemical compounds, the one being insoluble in the other; this passage of the water must be a purely mechanical action, and furthermore, openings, cracks, or crevices must exist in order to permit of its passage. In many cases the cracks are visible to the eye, while in others they can only be detected by submerging the insulated conductor in water for a time and then testing electrically. But even after proving the existence of these cracks, it remains to be determined that the static charge will be influenced by them.

As one means of testing the case, a plate of glass .072 of an inch thick was broken into two pieces and the two parts immediately fitted into their former positions and held together by clamps. The crevice or space separating the parts, was infinitesimal in width, as will be evident to any one who may have made a similar experiment. The restored plate was placed between two discharge points, in such position that the line joining the points passed through solid glass. Under these conditions I was not able with my facilities to cause a disruptive discharge to take place through the plate; but on moving it so that the line joining the points would lie in the plane of the fracture, a disruptive discharge occurred with an e. m. f. of 2067 volts and a capacity in the circuit of a microfarad. While this demonstrates the minuteness of the path required for a discharge, it is hardly a parallel case to what would exist in an insulated conductor, where the insulation was built up out of many overlapping windings of fibrous material, and then treated with an insulating compound, for in this case the cracks or crevices produced by temperature variations and the bending incident to handling and laying of the conductors will not be direct lines or planes from the conductor to the metallic casing, but angular or zigzag lines, following the interstices of the fibrous structure; this difference would result in the lengthening of the path of discharge, but scarcely to an extent sufficient to raise the resistance to discharge to the value of the insulating materials in a perfect state; and so long as the value is below that of the insulating material, the value of the constant a is also lowered, and it is therefore reasonable to assume that the conditions may become such as to warrant an affirmative answer to the second question.

Unfortunately both of the two grand divisions of conductor insulators, the fibrous and the non-fibrous, have their faults, for while the gbrous under some circumstances has the serious fault of cracking, the non-fibrous has the even greater fault of losing its insulating qualities and running off the conductor, when heated as might occur by an accidental overloading of a circuit, and when it is confined, as in a lead covering, it permits the conductor to become decentralized and eventually come in contact with the lead casing. Between the two insulators, with the faults specified, inseparably associated with them, there would, for high potential currents, be little or no choice, but fortunately means have been devised whereby the existence of the cracks or crevices in the fibrous insulating envelopes, when properly protected from water by a metallic casing, is immaterial, as they are sheared of the power of diverting the discharge into the paths opened by them. These ends are accomplished by the simple expedient of causing the discharge to occur at such a place and in such a manner as not to pass through the insulating envelope. This may be done in a great variety of ways, but the most simple one that has suggested itself to me, is shown in Fig. 3, where A is the lead covering; I the insulation; C the conductor: and P a wire connected to A and extending out beyond I, its end K being adjusted in relation to C so as to leave an air space slightly less than the thickness of the insulating material I. Under these conditions when a discharge occurs it will invariably be at K and not through I. While this simple arrangement illustrates the action and answers as a means of protection, it is evident that some device more durable and capable of adjustment would be preferable. A design meeting these requirements is shown in Fig. 4.

In Fig. 4, A is the lead covering; I the insulation, and C the conductor. Mounted on the lead A and held in place by the band V, is the metallic arm P, carrying at its outer end the pointed rod R. Another pointed rod R^1 is held by a projection on the ring B, which is mounted on the insulating brushing D. A fusible wire F connects the ring B to the metallic sleeve or collar E. The distance between the points R and R^1 can be adjusted and the rods held in position by suitable screws. It is evident that the operation would be similar to that of the device shown in Fig. 3. The electrical potential between the conductor C and the lead covering A before attaining a height sufficient to discharge through the insulation I, will discharge across the air space between the rods R and R^1, for these rods being in electrical connection with A and C, will attain their potentials, and the points of the rods will, according to a known law have an electrical density above that of A and C, or that requisite to produce a discharge across the inter

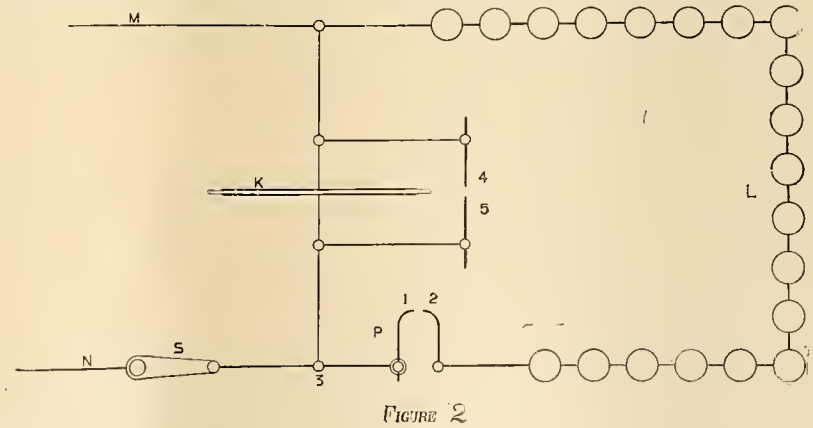


FIGURE 2

vening air. The fusible wire F is inserted as protection against injury to dynamos and cables in case of a ground existing on the other side of the circuit. There are several points, apparently trivial, but really of much importance, relating to the design and material of construction of a device for discharging a cable. The distance, measured on the exposed surface, separating the points of support of the discharging arms or rods, should be as great as possible, as there would be a loss of energy, across this space, in case the distance was small and dampness existed. Another point to remember is that the constant a should have a known value, and therefore the most appropriate design for the discharger is one employing points to discharge from and an unvarying intervening medium, such as air.

In order to obtain some definite information on the question raised by Mr. Leggett at the Pittsburgh meeting, as to the effect on the insulation, of a short bend or indentation in the lead of a cable. I caused a very deep dent to be made in a cable, so deep in fact that it would at once have been condemned in practical work, and then connecting it into the working circuit, an attempt was made to cause a disruptive discharge to pass through the compressed insulation at the point of indentation, but the attempt was unsuccessful, the discharge preferring to occur at any other point. Another experiment was made to determine the effect of

bending the cable backward and forward several times in the same place. A length was selected in which the discharge always occurred at either one of the ends, and after the bending operation had been performed a number of times, I was able to produce the discharge through the bent portion in preference to the terminals. These tests show the superior strength of the insulation in the more condensed or homogeneous forms, and the weakening effect of much bending.

In this connection it may be well to inquire more fully into the tendency of the discharge to occur at the terminals of the lead. It is a well-known fact that the greater number of the grounds or burn-outs occurring on arc light circuits are at the terminals of the lead, or at the joints, and it is precisely at these points that the charge, acting under well established and familiar laws, would be most dense, and owing to the presence of the edges or points for the electricity to flow from, the disruptive discharge will under ordinary circumstances take place between the edges or points, and the conductor within the insulation. Owing to the special facilities offered at these places, for the passage of the discharge, it is probable that in many cases, burn-outs occur under the influence of a charge that would be unable to produce a discharge through the continuous portions of the cable. In order to reduce the probability of a discharge occurring at terminals and joints, I would suggest that the lead whenever cut be made bell shape, in order that all edges or points be turned away from the conductor.

It may be appropriate at this point to consider briefly, that vexed question: Which way does the spark pass?

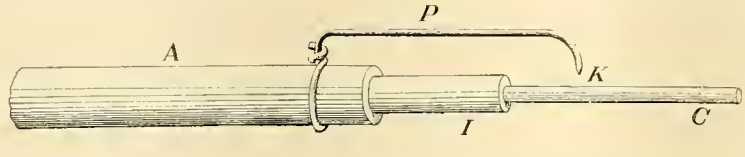


FIGURE 3

There is a relic of the past ages still existing, to a greater or less extent, among those who are unfamiliar with the present state of electrical science, and which I have no doubt many, if not all of you, have heard. The favorite way of expressing it is thus: "The earth is the home of electricity, and it is continually striving to get there by the quickest and shortest route." By this theory the electricity as represented by the spark would always jump from the conductor to the lead, and thence pass to the earth. It is plain to see the great weight this would have in an argument against the near approach of the conductor to the earth as is necessitated in the underground system of distribution. The direction of the discharge is determined by the form or figure of the charged bodies and the characters or signs of the charges on them, the earth playing no part other than that of a conducting medium. On the underground system there is, the moment before a disruptive discharge occurs, an unstable equilibrium between two points of the system or rather of the conductors forming the system and the insulations or dielectrics separating them. Through the line joining the points there is a strain produced by the difference of potential of the points, the tendency being to a neutralization of the potential differences. Against this strain is opposed the resisting power of the dielectric intervening, and usually consisting of the insulations on the conductors and the earth which separates them. The disruptive discharge that follows, may be either from a conductor to the earth or the reverse, but in neither case is there the slightest quantity of electricity left in the earth as a result of the discharge. It is a transmission of energy from one point of the system to another of a different potential, and the amount of electrical energy lost in the passage is expended in overcoming the resistance, and appears as heat.

From the experiments and conclusions of Faraday, I have made the following deductions:

1. When the charged bodies are of the same size and form, the *spark discharge* will, other things being equal, be from the positively charged body.

2. Other things being equal, less potential is required to produce a *brush discharge* than a *spark discharge*, and when it does occur, it will be from the negatively charged surface.

3. In all cases where the charge of electricity is on, or closely associated with the discharging surfaces, a diminution of either surface will facilitate a discharge, and when any considerable difference exists in their areas, the discharge will always be from the smaller surface.

4. A spark from a small body to a large one, will be from eight to ten times greater in length, when the small body is charged positively, than it would be with a negative charge.

In general, the direction of the discharge between the conductor and the lead, through the insulation, is subject to the form of the surfaces of the conducting bodies; a slight burr or point on either one being sufficient to determine the direction of the spark.

In a series of very interesting articles by G. L. Addenbrooke, in the London *Electrical Review*, the subject of spark length disruptive discharges and the advantages of a perfectly continuous and unbroken dialectric are extensively treated. The influence of the capacity of the cable is, however, entirely neglected. Special stress is laid upon the advantages of a continuous envelope of insulation, and those using rubber covered conductors are particularly cautioned against handling or bending them when the temperature is lower than 45 degrees Fahr., as fissures or cracks are then liable to occur, and permit of the passage of discharges. This I confess was information to me and puts a certain limitation to the qualities I have given to rubber in the paper which was written before the statement of Mr. Addenbrooke came into my hands.

As the experiments referred to in this paper have extended over a considerable period—not less than six months—there have naturally been a number of questions and points presented from outside sources. Others have been led into the field to experiment, and with the equally natural result of obtaining in some cases effects that they have construed to be at variance with those I have secured. I have one case in mind where the experimenters found it impossible to produce a disruptive discharge so long as the lead of the cable was insulated from the ground, but the grounding of it made the production of the discharge feasible, and they concluded that the theory of a disruptive discharge was not correct. This is a repetition, under different conditions of the very old experiment of attempting to charge a Leyden jar with the jar insulated. The first condition to be arrived at in the charging of a jar is the grounding of one of the surfaces. A disruptive discharge through the insulation of the cable cannot occur without a charge being first formed, hence it is absolutely necessary that a ground be made to the lead. The resistance of the ground connection to the lead is, to a very great extent immaterial, as the charge is cumulative, and the energy expended in the discharge is only that held in the charge, hence though the ground resistance may be many megohms in value, and the charging process extend through a considerable time, there will eventually be a storage of energy on the surface of a value sufficient to rupture the insulation, at the first change in the charging current. The spark discharge is all but instantaneous in its action, and with the work restricted to this inmeasurably short space of time it is necessary to leave the energy on hand, as it were; there is no time to generate it, electrically, at the dynamo and convey it over long or even short distances. The subject of disruptive discharges with various resistances and self-induction placed in the path of energy, is beautifully treated in a paper read by Dr. Oliver Lodge before the Society of Arts, April 17th.

One word more before closing this subject. It is safe to predict, that the disruptive discharge being provided for, little or nothing more would be heard of the much talked of pinholes in the lead, and the moisture absorbing terminals; the undergrounding of arc light cables would become a thing of certainty, and our municipal governments relieved of a great bug-a-boo.

THE PRESIDENT: The next paper will be a description of an underground conduit, by H. C. Chenoweth.

DESCRIPTION OF AN UNDERGROUND CONDUIT.

BY ALEX. CRAWFORD CHENOWETH.

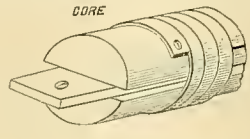
The changing of electric light conductors to an underground system having engaged the attention of this meeting, I will place before you a method of constructing ducts that can be so arranged as to meet many of the objections heretofore presented. The object of this paper is not the discussion of the merits or demerits of systems that have already been presented, but its purpose is to invite your criticism of the practical points of the method I am about to describe. Let us assume that the question of insulation has been settled and that the arrangement of the conductors in a structure permanently located is such that it can be augmented at small cost. This is done in order that the question of cost may be met. The material of which these structures must be built must withstand the forces of nature that are brought into action in their new relations. Concrete, a mixture of Portland cement and sand in suitable proportions, well incorporated, answers all the requirements. The form of the structure requires a system consisting of ducts four inches in diameter with large manholes located at convenient points for the purposes well established in previous discussions, with other entrances to the ducts, through openings located at intervals, to be used when required, connecting points to houses and stores. All parts are to be constructed with smooth interior, free from joints, faults, depressions and water tight.

The structure is formed by means of a core, consisting of a wooden cylindrical rod, 14 or 20 feet in length, which is cut in two, forming two half cylinders. The space removed by sawing through the rods, when each of the halves are placed together, is occupied by an iron rod, having a thickness equal to the portion removed by the saw, restoring the cylindrical shape; this forms the mandrel or core shown in the illustration.

Now, a ribbon of galvanized iron, one inch wide, and of a thickness equal to 27 gauge, is wound spirally around the mandrel of wood, from end to end, securing the ends with a fastener to the wood, to prevent unwinding. The outside of the core is now painted with a mixture of clay, powdered soapstone and water.

The core thus described, is ready for use. A ditch is prepared, and the core is placed in it, resting on cross pieces of wood; if more than one duct is to be constructed, other cores are ranged side by side. The concrete in a plastic state is now tamped well around, bringing the top to an even level. The iron rod is now removed, as well as the pieces of wood on which the ends of the core were resting, also the fastenings of the ribbon ends. The wooden half cylinders are now drawn out, leaving the spiral casing, which remains for several days.

A new core is inserted in the end of the spiral, the rib



CHENOWETH CONDUIT CORE.

bon of the old core is fastened to a ribbon of the new core by a swivel, and you proceed in same manner as before, thus constructing several hundred feet with the casing remaining in. When the cement hardens, the casing can be drawn out, being a spiral. This is done at any manhole or unfinished portion of the work. As the spiral ribbon is removed, the surface coating of clay and soapstone adheres to the interior of the duct, producing a smooth surface, and acts as a lubricant to reduce friction, when conductors are drawn in, thus preserving the insulation. This construction insures a monolithic structure, with smooth interior, and is straight, free from joints, depressions, and is water tight by reason of its construction.

At the same time, in case you should require another duct, the wall on one side is always ready, by merely placing a core on top or on either side, and proceeding in the same manner. This reduces the cost of a new duct. The most convenient arrangement for distribution purposes suggests a line of two holes on each side of a street, with manholes at intersecting streets, and openings at every house lot subdivision.

I have adopted an opening in the form of a cast iron nozzle, with a hole into which a pipe can be screwed, by removing a screw plug. This is set in the cement when the duct is constructed, leaving the nozzle projecting only. This can be modified to suit any size or shape, or the nozzle can be replaced with a box having a lid. This form of construction will permit the conduits to be placed near the surface. The elasticity of concrete enables it to withstand the blows caused by heavy traffic. It is an easy matter to project a conduit of this form from a manhole to an insulated point, and afterward to construct others alongside at small cost.

The cost of constructing ducts by this method is narrowed down to the winding of the ribbon on the mandrel, the labor of removing the mandrels in the trough, of removing ribbon from the duct, and rewinding the ribbon on the bobbins. And as each part of the core is preserved and used an indefinite number of times the cost of the core is charged to the cost of plant; it costs ten cents per foot. The winding of the ribbon is done on the spot as fast as wanted, and costs two mills per foot. The cost of drawing out the ribbon and rewinding on bobbins, using an ingenious device that removes all twists, is about one mill per foot. The labor of removing the wooden mandrel in the trench costs about one cent per foot. A duct four inches in diameter, made of concrete, in the proportion of one of cement to two of sand, can be made for four cents per foot including entire cost, exclusive of excavation,

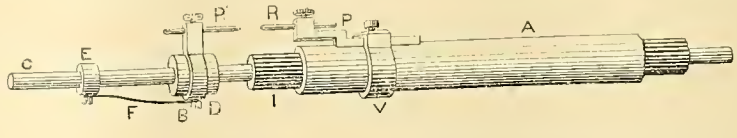


FIGURE 4

manholes and openings. If a repair should be found necessary a block can be made with a duct through it, and inserted between the two ends thus to be joined, leaving a space of one inch at each end. Insert a spiral sleeve inside of the duct made of iron, a wire fastened to the end of ribbon forming the alcove, also connected to the alcove at the other end of the block by a wire. Then extend to nearest opening. The cement should be packed between the ends firmly, the sleeve preventing the cement from entering the conduit. When the cement forming the joint becomes hard, the sleeves can be removed by hauling on the wire at the opening.

At the conclusion of Mr. Chenoweth's paper, the chair announced as the committee on president's message, Arthur Steuart, of Baltimore; A. F. Mason, of Boston; J. Frank Morrison, of Baltimore; E. R. Weeks of Kansas City, and H. D. Stanley, of Bridgeport, Conn.

MR. LYNCH: Before we adjourn, I would offer the following resolution:

Resolved, That a committee of five be appointed by the chair to examine into and report upon the systems of underground conduits for underground conductors, and conduits now in operation, and the number of wires actually in use in those conduits, and report at the next convention of this association.

The motion was seconded and adopted, and the convention adjourned until half past two o'clock this afternoon.

AFTERNOON SESSION.

The president called the meeting to order at 2:30 P M., and read a communication from C. J Field, stating that arrangements had been made so the members who attended the Broadway theater could examine the interesting electric light plant there. He also read an invitation from the Shultz Belting company to examine, at an establishment in New York, a belt said to be the largest in this country.

THE PRESIDENT: We are now ready for the discussion of the three papers which were read this morning. I see that Mr Wheeler is present. Some of the gentlemen, after the reading of his paper, asked questions which the chair stopped, as they were leading to a general discussion, but Dr. Wheeler will be ready to answer now any questions which may be asked him

MR. LYNCH: I would like to ask Dr. Wheeler what number of wires it is proposed to put into these two and a half inch ducts?

DR. WHEELER: I do not know exactly how many it is proposed to put in. I suppose it will depend on the number the ducts will hold There is now being drawn into them a cable containing eight arc light conductors, each one of which is equal to a No. 4 wire. They are made a trifle larger than the ordinary overhead conductors. That makes a cable which, including the lead covering, is about two inches in diameter. I should think it hardly advisable to draw a larger cable than that through these tubes; but hereafter, probably, there will be no cables drawn in containing more than one arc light conductor. They will be drawn in singly. The objection to a cable containing a number of conductors is, that it limits the use of the cable to carrying a number of wires all forming the positive or negative side of the circuit, while, if you make them up into single conductor cables, you can arrange them to suit the convenience of business, and you have an increased amount of insulation between opposite wires.

MR. LYNCH: How far is this cable to run, Dr. Wheeler?

DR. WHEELER: From Fourteenth street to Thirty-fourth street, on Broadway.

MR. LYNCH: What is it to be used for—trunk lines?

DR. WHEELER: I do not know exactly: I think not from the fact that it is proposed to cut it in two at each manhole.

MR. LYNCH: Have any supplementary conditions been made?

DR. WHEELER: None have been laid that I know of for the use of arc light companies. The method has been adopted and the materials are being prepared to lay a system from 14th street to 34th street on Broadway.

MR. LYNCH: Is that the Johnstone system you spoke about?

DR. WHEELER: Yes, sir.

MR. LYNCH: What is it proposed to charge as rental per mile?

DR. WHEELER: I do not know For that I will have to refer to the representatives of the conduit company.

THE PRESIDENT: Dr. Wheeler, will you allow me to ask you a question? If the city authorities have charge of the streets and are responsible for that conduit going in there, how then are you going to hold the owners of the lateral wires responsible for anything at all? How do you propose to do that? Has the commission got any plan on that point?

DR. WHEELER: It occurs to me that that is a question of law, and I am here as an electrician—not that I have any objection to answering the question, but I do not know the answer

THE PRESIDENT: I see. But is the representative of the law department here?

DR. WHEELER: I would like to refer that question to Commissioner Gibbens, if he is present. I do not see him.

THE PRESIDENT: We are seeking for information and we are as desirous of a solution of the problem as the municipal authorities are When we get to a point where there is a dead line drawn and the municipal authorities cannot give us any information, we must stop right there. If there is a point where we can give you information, we are desirous of aiding you.

DR. WHEELER: I am very desirous of having all possible information given to the association in order to make the conclusion reached as valuable as possible, but in the absence of Mr. Gibbens, perhaps Mr. Leslie, who is present, and is the manager of the Subway company, might answer that question.

THE PRESIDENT: You understand the proposition that as the municipal authorities, by law, take charge of the mains and regulate the size of the conductors, etc., and become responsible for those mains in the street, then, as I understood the proposition this morning, the companies who would feed off from those conduits would be responsible for the lateral mains. Is that correct? Now then what we want to know, if we can get the information, is this—where the responsibility of one commences and where the responsibility of the other ends? If we can get that we can possibly get into the meat of this business.

MR. LESLIE: As I stated this morning, I think the responsibility of the subway company ends in providing a suitable subway for the accommodation of such conductors as any electric light company or any other company may see fit to draw therein. They are responsible for the kind of insulation and for the operation of their own plant; they own it; we do not. We simply own subways which we lease to them.

THE PRESIDENT: Then, in other words, as I understand it, the city authorities have practically made a monopoly of the underground business of the streets and given it to a certain company without any specifications as to the character of the conditions that the sub companies must undertake to fulfill in making connections with the main conduit system. Is that it?

MR. LESLIE: In the first place, as I understand it, when the commission was created each and every person interested was invited to submit his plans for such a system as in his judgment might be most suitable to business purposes. Having failed to do so the Subway company has since observed the same practice and each and every company in New York, doing business here, has been invited to state what in their judgment would be most suitable for their purposes. I think the attitude of the Subway company in that respect has been most consistent. If a man wants anything and asks for it and gets it, I do not see that he can ask for any more.

THE PRESIDENT: Then, as a matter of fact, the Subway commission of the city does not say to the electric lighting companies that they must observe proper sizes of wire, and everything of that kind. They leave that to the discretion of the company.

MR. LESLIE: Entirely so.

THE PRESIDENT: They simply ask them to make a recommendation?

MR. LESLIE: They ask them to go underground.

THE PRESIDENT: And if it does not suit the conduit company, what then?

MR LESLIE: We have had no such emergency arise as yet.

THE PRESIDENT: Is there a basis then established by the Subway commission or the company under the Subway commission? Is there a set of fixed charges established?

MR. LESLIE: Yes; sir.

THE PRESIDENT: Have you received answers from the companies in regard to that question?

MR. LESLIE: We have met with no opposition in that respect from any company in the city except one

THE PRESIDENT: They are all perfectly satisfied with the rate of charges?

MR. LESLIE: They appear to be so. They think it to be just and equitable.

THE PRESIDENT: In the furnishing of this subway do you give any guarantees to these companies as to the permanency and the reliability of the system that you put in?

MR. LESLIE: We agree to keep the subways in good order. But if anything that could not be anticipated should arise to interfere with their business they would be in position to be reimbursed for any loss they might have incurred during that time. We guarantee to give proper subway facilities or we do not charge any rent; that is the best we can do. If we should happen to have some extraordinary accident which no one could anticipate or provide against, in that case we should, of course, abate any rental until such time as we could put the subways in good condition.

THE PRESIDENT: Then there are no conditions by which a company held responsible for lighting so the public could obtain redress for a light being out for a period which would be practically inconvenient, and would cause the public considerable delay.

MR. LESLIE: I do not know of any guarantee beyond that which I have stated.

THE PRESIDENT: That is what I understand Then it is the companies which practically lose the amount of revenue that would be derived, instead of the Subway company that puts in these conduits.

MR LESLIE: Well, I presume so They do so now with the overhead system

MR. PERRY: This is a subject that is entirely new to us and we may have to meet it in our own various systems, and I would like to ask what are the rates of tariff which are established here, and if the city of New York gives into the hands of a corporation the right to lay these subways without any limitations as to what tariff they should charge, and then say to the companies you must go in, no matter what the rates are? I would ask if there is any limitation of the tariff, and what the rates of the tariff as established are.

MR. LESLIE: I will say with regard to that matter, that the companies are amply protected The law on that subject reads that such a rental shall be charged as is fair and equitable. Any company imagining itself imposed upon in the matter of rental can have recourse to the Board of Electrical Control, which has the right of revision at all times I regret that I have not with me a copy of the law on the subject which I imagine from the inquiries which have been made would have gone very far to enlighten the gentlemen present. There is no opportunity for unjust action.

MR. PERRY: The other question which I asked the gentleman through the chair was what are the rates of tariff as established, briefly?

MR. LESLIE: When I came up to this convention this morning, I had no idea that I should be called upon to furnish any information whatsoever, and therefore I have not provided myself with statistics. I came here to listen to Dr. Wheeler's paper, which I understood he was to read. Nevertheless, if my memory serves me right, I have no hesitation in saying that our schedule of rentals is $1,000 per mile per annum, for a three inch duct; $800 per mile per annum, for a two and a half inch duct; $750 per mile per annum, for a two inch duct; $550 per mile per annum, for an inch and a half duct. I will say that with regard to the two inch duct I am not clear whether it is $750 or $650, not having the data, as I said before, with me.

THE PRESIDENT: You will understand, Mr. Leslie, that these questions are not asked in an inquisitive way to ascertain the private business of the Subway company; but New York has been looked to from all over the United States as the point where this question is to be solved. We have been invited by the mayor to go into the merits of this case if we can, but there is no use in going into the electric part of it unless we can get at the financial part of it too. You must not think these questions that are asked you are simply put to ascertain the business of this corporation. It might seem that they were put in that spirit; but I want to assure you that that is not the case. We want to put these two things together and see what we can make out of it

MR. LESLIE: I appreciate that Mr. President, and I want to say that while the scope of our operations is local, yet we recognize the fact that the underground problem is universal, after all, in its application, and that in most of the prominent cities of the United States you are all face to face with the same question, and that the developments of underground facilities in other cities is going to be directly and indirectly a great help to us here in New York. I desire to say further that if any individual member of the convention desires any more definite information upon the underground system, which we may possess, and if he will apply at our office at 18 Cortlandt street, in this city, we will very gladly give him all the information that we have.

MR. DE CAMP: As I understand the matter, when the question was referred to the subway committee they invited the different electrical interests to state to them what was necessary for a successful solution of the problem of laying underground wires These different electrical interests, particularly the electric light interest, made no response to that, for the reason which is manifest to every man engaged in the electric light business; but they had no suggestions to make because they knew nothing On the strength of that the subway commission took upon themselves the responsibility of deciding upon some conduit which, in their judgment, would answer the purpose. Those conduits have been put down, not upon any merit that has been demonstrated that they possess, but as mere mechanical constructions they seemed the proper thing. After that is done then comes the pressure to have the electric light companies put their wires in them That pressure is brought to bear very forcibly, because it is backed up by legislation They are the parties who have assumed the responsibility of deciding for the electrical companies in putting down a certain conduit; they throw off the mantle of their responsibility and say, "Gentlemen, occupy those conduits at a rental of so much a mile." The only risk that they take in the matter is in keeping the conduits in repair. That is one which they cannot very well shirk. They throw the burden on the electric light companies, and, as the chairman very pertinently puts it, who is responsible to the electric light companies for the loss of service to the public in the municipality by reason of the failure of the conduit during the time it is necessary to repair it? Not only that, but the failure on the part of a cable or conductor that they put in, though not upon their own judgment, but upon the judgment of the parties who put the conduit down. There is a consequential consideration or risk there which, in my judgment, it is unfair to impose upon anybody. That is about the way, as I understand, that the thing stands to-day. There is only one certain element in that for the companies using that conduit, and that is to pay rent. That is about the way it stands. But leaving that right there, this is what has always occurred to me from the time this question was agitated. It has been taken hold of at the wrong end absolutely. I never saw a more preposterous method of accomplishing a thing in my life. Mr. Lynch asked a question this morning about a certain conduit in Philadelphia. That that conduit, in my judgment, is a good one, goes for naught. I do not care how good it is, and I do not care how cheaply it can be built, I have got absolutely nothing to put in it that will answer the purposes of our business—absolutely nothing; and here you go to work and you devise a convenient method of transacting a business which you admittedly do not know how to carry on. There is not a man to-day who is willing to take the record of the aerial lines as a basis for operating and that is of no mean importance, because the investment of a vast amount of capital and its earnings is based upon the amount of money in those constructions, and you never get any more out of it. You have reached the maximum reward of the investment of your capital. The public has given it to you, and given it to you willingly. They say to you: Your business now, young as it is, is old enough for you to have learned something, and you have brought the business to a point where it ceases to be a luxury to those who want to use it. The city of New York paid 70 cents without a murmur in the first few years of that business. They declined this year to pay 50 cents They declined to pay 45 cents, and there are plenty of cities in the country that are paying less than that. They say it is too expensive. Therefore, you have got to weigh with great deliberation anything in connection with your business which compels you to increase your prices, or to maintain those you have already established. Now, as I say, they have taken hold of it. They have left that for the men, and the only men who, in my judgment, are capable of deciding that question, to accomplish. They put down these ducts; they have occupied the streets, and they have left the companies who shall choose to use them to accomplish that great end of getting something to put in them. Now I asked the question this morning of Dr. Wheeler, who represents the Subway commission, what this costs. He does not know The matter is referred to Mr. Leslie; he does not know; and from all I can learn nobody has ever taken the trouble to consider the cost of this thing. Now I want to submit that as a method of doing business. (Applause.) When I go to my people and say, "There is a report; it involves the introduction of new machinery, the addition of a few boilers, the addition of some electrical apparatus that will enable us to do so much business; it will increase our business 10, 15, 20 per cent," do they say, "Go on and do it?" It is just what they want done, but before they do that they ask, "What is that going to cost?" I do not care if it is a matter of a thousand dollars Everybody knows an increase of business, particularly in the electric lighting business, is desirable. Does your board of directors say go on and do it without knowing what it is going to cost? No; nobody does it. Individuals do not do it, corporations do not do it, and yet that is the very thing the subway commission appear to have done. Look at those drawings Are they submitted to the practical people? If they are, very naturally it will be asked what am I going to do with it when I get it. They cannot answer that question, but they have gone before the authorities of the city, who are pressed on all sides to do a very desirable thing. Their plans look very feasible as a piece of engineering They no doubt are feasible. His honor the mayor of this city takes the most sensible view that ever I knew a public officer to take (Applause.) He is a man who has the courage of his convictions, and it is a great wrong to the electric interests to-day that there are not more of our municipal officers who seem to have the same courage. The mayor of this city stands in a position which no electric light company dare antagonize If this subway commis-

(*Continued on page* 129.)

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CONTENTS OF THIS NUMBER.

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

Members and Guests.... 115, 116
President Duncan's Address ... 116
Mayor Hewitt's Welcome..... 116 117
Testimonial to Ex-President Morrison.... 117
Report of Executive Committee 117
Insulation and Installation of Plants, and Discussion ..117, 118, 119
Petroleum Fuel by S. S. Leonard, and Discussion.....119, 120, 121
Centennial Exposition of the Ohio Valley and the Central States. 121
Overhead and Underground Wires in New York, by Dr. Schuyler S. Wheeler, Illustrated, and Discussion, 122, 123, 124, 127, 129, ... 130, 131, 132, 137
Disruptive Discharges and their Relations to Underground Cables, by E. G. Acheson, Illustrated, and Discussion, 124, 125, 126, ...127, 129, 130, 131, 132
Description of an Underground Conduit, by Alex. Crawford Chenoweth, Illustrated, and Discussion ... 126, 127
Editorial.... 128
Revised Constitution 132, 133
Report of the Committee on New England Electric Exchange 133, 140
The Comparative Danger of Alternate and Direct Currents, by P. H. Van der Weyde, M. D., and Discussion..... 133, 134
Some Methods of Electrical Measurement, by G. A. Liebig, Jr., and Discussion.... 134, 135
Electrical Education, by Edwin Ruthven Weeks, and Discussion 135, 136, 137
A Basis from which to Calculate Charges for Electric Motor Service, by H. F. Lufkin, and Discussion.... 137, 138, 139, 140
Notes.... 141
Exhibits.... 141, 142
Eugene Phillips' Clambake.... 142

THE report of the committee on the New England Electric exchange will be read with interest, especially in view of the fact that such an organization is contemplated in Chicago.

IT is clear that the mantle of the retired president fell on worthy shoulders when it was deposited on those of S. A. Duncan. He makes a good presiding officer, and, so to speak, "holds the convention down to business."

DR. VAN DER WEYDE'S contribution to the papers read before the association on the comparative danger of alternating and continuous currents, merits careful reading. It is clear and thoughtful, and deals with a topic of commanding interest at the present day.

THE next meeting of the National Electric Light association will be held in Chicago. The selection of this city for the honor is eminently fair and just, and in return Chicago will extend its hospitality, and endeavor to make the visit of the association both pleasant and profitable. We now bid the association a hearty welcome to the metropolis of the west.

MAYOR HEWITT'S address was one of the most striking features of the convention. As a speech addressed to a body of intelligent men gathered for an earnest purpose, it may well serve as a model. It was characteristic of the man. It abounds in humor and apt allusions, but above all it evidences careful thought and study. The address when circulated cannot fail to work to the advantage of electric companies, and tend to check the inconsiderate action of municipal bodies, which forms one of the greatest obstacles to progress. Mayor Hewitt thoroughly appreciates the difficulties which beset the companies in the metropolis, and he sets his face against hasty measures which shall tend to augment them. The speech has made the situation clear in New York, as it has never been before. The action taken by the convention shows how thoroughly the address was appreciated, and how highly its importance was estimated.

THE presentations to J. Frank Morrison, the first president of the Electric Light association, constituted a well deserved tribute to a gentleman who labored zealously and successfully to establish the organization upon a sound basis. The association is now a strong, compact body and it pursues its ends with vigor. To Mr. Morrison belongs the credit in no small degree of bringing the association to its present prosperity.

THE committee on patent legislation, through its chairman, Arthur Steuart, explained the steps that had been taken since their last report to the association. The proposed bill was laid before our readers several months ago, and we believe its provisions have received wide commendation. Mr. Steuart imparted the pleasing intelligence that the judiciary committee of the house of representatives had decided to report the bill favorably.

IN view of the rapid extension of the motor business H. F. Lufkin's paper and the classification of charges for this service was timely and will be read with interest. His suggestions, as they relate so closely to modes of increasing dividends, appeal very strongly to every stockholder of an electric light company. The figures which he gives are valuable as they have been verified by experience sufficiently long continued to render them reliable.

MAYOR HEWITT asked the convention for enlightenment on the underground problem. Dr. Wheeler, Mr. Acheson and Mr. Chenoweth presented able papers, and between them and the discussion a very clear exposition of the present status of underground work was laid not only before his honor, but before all the members of the association, and through the columns of the WESTERN ELECTRICIAN is now placed before a host of readers. This subject received perhaps the largest share of attention of any presented for discussion. It proved a fruitful topic, and will merit the most careful perusal and study.

WE offer this issue of the WESTERN ELECTRICIAN to our readers with some feeling of pride. It gives a complete report of the proceedings of the National Electric Light association; it is handsome, and it appears promptly on the regular day of issue. When the distance from New York, the place of meeting, the immense amount of matter that had to be taken in shorthand, transcribed, travel 900 miles by mail, be edited, set in type, corrected, placed in pages, printed, bound and mailed are considered, we believe our readers will appreciate our enterprise—more especially when all this has been accomplished in such short time without sacrificing any part of the report.

THE paper of E. R. Weeks on electrical education treats of an important subject in a way that cannot fail to excite general interest in the practical scheme which the Kansas City company has inaugurated. The policy adopted by that corporation of furnishing means by which the employes may become thoroughly grounded in the principles which underlie practical work is of the most liberal character and the example thus set can be followed to advantages by the great majority of companies. The plan outlined by Mr. Weeks has a very wide application. Not only electrical companies but all corporations which require the services of skilled, intelligent trained employes will find that such a plan is well worth a careful investigation. In these days when the "soulless corporation" is so soundly berated by the public prints it is a satisfaction to meet with a case, like the present, in which a company strives so earnestly and successfully to advance the interests of its employes. Would not the general adoption of some such policy tend to aid in the solution of the much discussed labor question? The plan must commend itself to every one and the character of the discussion by the convention gives evidence that the members thoroughly appreciated its importance.

WHEN S. S. Leonard penned the note to President Duncan placing a low estimate upon the value of his paper on petroleum fuel, he little thought what a wide interest the presentation of the paper would excite; but the results of actual tests, he so modestly offered, were enough to elicit a fruitful discussion.

Nine months ago the WESTERN ELECTRICIAN noted the tendency of a number of electric light companies to adopt not a new fuel, for it has been known for years and used in numerous instances, but to use it under new conditions; consequently we took the opportunity to show the readers of this journal, several of the latest types of crude oil burners.

The subject as a whole has a live interest to those electric light companies who occupy high priced real estate in cities where storage capacity is limited and haulage is costly and we trust those who are investigating the subject and making experiments will lay the results attained before succeeding conventions in a plain, practical and thorough manner as Mr. Leonard.

In the discussion a member adverted to the danger of burning out boilers when petroleum was used as a fuel. No boiler user is not aware of the baneful results that will ensue when the heat of the fire is largely concentrated on one spot on the shell or on the tubes. The natural consequence will be a leaking boiler and general repairs. But with improved devices for distributing the heat uniformly there seems to be no reason why this objection to the use of crude oil should not be removed.

EVEN those most familiar with the tremendous progress of the electric light industry must marvel at the figures given in President Duncan's address to the convention. "At Pittsburgh," said the president, meaning the time the convention was held in Pittsburg in February last, "it was estimated that there were no less than 4,000 isolated plants and central stations operating 175,000 arc lights and 1,750,000 incandescent lights. To these figures we may now add 1,351 new isolated plants and central stations operating 35,201 arc lights and 292,944 incandescent lights, of which I have a detailed record. By adding this increase to the figures of six months ago we find that there are now 5,351 isolated plants and central stations, and there are burning every night in the year in the United States no less than 192,500 arc lights and 1,925,000 incandescent lights. We may also add that there are 459,495 horse power of steam engines devoted to electric lighting. Figuring this in coal consumption it can be demonstrated that in the year of 1888 enough coal will be consumed in the United States for electric lighting purposes to make a solid column 100 feet square and over a mile high. It may be here parenthetically remarked that there has been an increase in the capitalization of the electric light companies of the United States in the last six months of not less than $342,210,100."

These figures are as colossal as that column of coal, but they can be accepted as authoritative.

It would be a wanton act to disturb the reveries of one dreaming of the future of the electric light and erecting a superstructure of magnificent proportions in the foundations laid by the president, but cruel necessity forces us to state a fact that may be overlooked. The data showing the increase in the number of stations and lights must have been gathered between February and August. These six months do not include the busiest season of manufacturers of the electric light, namely, the fall months, for the general experience in the west at least is that August, September and October, or the months preceding the long dark days of winter are the busiest months. What figures can be expected then, at the next meeting of the association?

(*Continued from page* 127.)

sion brings forward a system, and he carries out his intentions of enforcing it, I do not believe there is an electric light interest in the city of New York that dare for a moment antagonize him. Certainly there is not in Philadelphia an electric light interest that would dare to antagonize a municipal officer taking such a position. Now that is a sensible view to take of it. It is a question of dollars and cents, as has been many times asserted on this floor. That assertion amounts to naught until the amount of these dollars and cents is stated. It is a very different thing whether a thing costs a million or costs twenty million dollars. This thing carried on to the extent it is carried on in New York, if I have an appreciation of the subject at all, would ruin every electric light company in the United States, and every dollar of capital invested in it would be wiped out. No industry that ever started has sustained itself as this interest has sustained itself since its inception. Gas companies never met with the same obstruction nor did any other public industry. Just as soon as they impressed themselves upon the minds of the public that they were a public necessity every facility was offered and no obstacle was raised up to make that objectionable; and we are met here with this very fact, as I say, commencing at the wrong end to accomplish something before we know how to accomplish it You speak of the guarantees I can readily see how the commission cannot assume that responsibility. It is utterly impossible for them to do it. It has been said here, and very frequently said, by certain parties that they will put the cable in with a guarantee. Now I understand that that has been done here in the city of New York. I am curious to see in what form that guarantee is. If that guarantee simply means we will put that cable in there and run it for a year or two or three years, and in case it fails we will take it out and put in a new one, why, in my judgment, it does not mean anything. Who would think of renewing the gas pipes in the city of Philadelphia? What electric companies at the present comparatively low cost of aerial lines would think of renewing their aerial lines once in ten years absolutely? It would make the business prohibitory The substitution of a new cable is no small job; the consequence is that while it is being substituted the city is without light. Now that is a thing that the companies themselves should be compensated for. It is not likely they would be But at the same time if that thing is done, then electric lighting as a public illuminant is a failure—an absolute failure. In the city of Philadelphia, and I think, in the city of New York, there was not a gas light turned out on the line of electric lights for one year after they were started. Why? Because confidence was not established in it People thought it might go out. But gradually confidence became established, and now wherever it is possible gas light is turned out and the very occasional failure on the part of the electric light has justified that confidence. I am sometimes amused at the easy, self satisfied way in which people say, "What does it do? Pull this right out and put another one right straight in." On the same cable, within two available points for making the change, there may be half a dozen different connections, all of which have to be unsoldered and the cable taken out, another put in, and the cable soldered up again; that means a delay and the loss of a certain order, public or private, and I assure you—and any man that is in the business needs no assurance—that such a thing as that would not be tolerated Customers would say, "The thing is too uncertain; we do not want it. If these things are to occur even occasionally, it fails to answer our purpose." When it comes to that, gentlemen, your electric light as a common and public illuminant, is a failure.

Now I am just as anxious as any man to have this question of underground wires solved, and I believe every company in the country is willing to do their share of it, and are making the best efforts to do it, but you can readily conceive when you look at the city of New York and note the progress that is being made in it—I mean the substantial progress—that it is not very encouraging to us to go to our companies and ask them to spend money to repeat the same operations that have been made in New York That is not business. We have a perfect right to benefit and profit by other people's experience. It is one mode of education that we have without paying for. In the city of Philadelphia we have made our effort. It is not expected that the people of Baltimore in the same line of business will go and do just the same thing that we are doing, but every effort has been made in Philadelphia from a straight, square, out and-out business standpoint from an investment of capital to meet the public demand. I declare here, without fear of contradiction, that it has been an absolute failure, and I consider it a great misfortune to the interests in general that I am not able to s and here and say definitely why that has been a failure, except on very general principles. But the party that has been endeavoring to make a success of that has had every interest in the world to bring success about, and yet it is a failure, and there is no denying it. (Applause.)

Prof. Van der Weyde: Mr. President, our mayor, in spite of the fact that he said he did not understand much of the electrical business, gave us the very good advice to devote our efforts to solving that great problem. I have been attempting to solve it for some years. When I first saw that the wires would have to go I made individual experiments and have patented cable. I have also obtained patents for anti-induction cables, but in the place of getting up a company to try to introduce it, I put it to a severe test myself, and I found, after burying the cable, that it did not stand the honest test; and therefore I have not come before the public or before any company with my patent. The position of the matter is this: There are two things to be accomplished by us. In the first place we have to devise a subway which is available in a large city, so that the cables can be gathered. It is a significant fact that, in the city of Paris, where they have the most magnificent opportunities for putting the cables underground in their sewers, only the telegraph and telephone cables go through the sewers, and all the electric light cables, as stated this morning, go over the roofs of the houses. It has been found impracticable in Paris. It is a problem to be solved. We must find first the proper cable to put under ground, and then the proper subway. We have seen this morning a cable passed through the tubes. That is very good, very useful when we have to go a considerable distance, like passing over the Brooklyn Bridge or the approach to the bridge, for instance, through Frankfort street; it is splendid in such a case, or up town through Broadway. But if we want a system where every wire is accessible, it is insufficient. Such a system has yet to be devised. In the second place, proper cables have to be devised which will not give out, and the best we can do —it is what I have done, Mr. President—is to recommend this body to make their individual effort to improve the things we have and to get subways which will answer the purpose and to get the proper cables. In Brooklyn, for instance, the subways have been laid down under my sight, as it were. I saw them from time to time, living there. Three years ago they were begun, and what has been the result? They are now pulling out the cables they put in three years ago. The cables have been found insufficient. If things had been begun after we had the proper information, then such losses would not have occurred.

Dr. Moses: Mr. President, I have just received a dispatch, which exemplifies better, I think, than almost anything else one of the bursts of eloquence of the mayor which he gave us yesterday. He said he would like to see electricity really the servant of man for the good of all. The dispatch exemplifies how electricity may come to our aid and bring those who are in sympathy with us, though 3,000 miles away, right within sound of our voices and close enough to touch the chords of our hearts: "Dr. Moses, Hotel Brunswick, New York: Reckenzaun and friends send greeting to the convention." (Applause.) Gentlemen, while I am upon the floor, I would like to correct an impression coming from one of so sound judgment, painstaking, experimental character and experience as Prof. Van der Weyde. I would like to correct a statement that he made with which you might otherwise go away too deeply impressed. He says that the subways in Paris have not been used for reasons which would lead you to infer that it is due to the fact of the incompleteness of our knowledge in distributing electricity through conduits. That is not the case. The facts of the case are these: The city of Paris and the gas company are in a close partnership. They do not want to have any electric lights there because one of their chief sources of revenue is gas. We often hear a great deal said about Paris being the representative city for everything that is in advance in science, art and luxury, and we are inclined to say this thing should be developed there. To-day there are not half a dozen arc lights in Paris outside the Place du Carroussel. The reason is, the city put every impediment in the world in the way of electric lighting. It is bound to come though, and those who are deeply interested in the subject in Paris are bringing it about in the following way: A company has been started in Paris, which is seeking rights from the municipality to introduce a system of power throughout the city of Paris. They entirely ignore the uses of it—electric light, transmission of power for motive purposes, for electrolysis, for all the uses to which we apply here are entirely ignored by them, and they propose simply to sell power. Now, when the time comes, of course, for the distribution, it is not impossible that the magnificent system of sewers which underlies Paris may be utilized by any company that may have the right to do it. That right will only be conferred on those who can give guarantees. Those who are introducing the electric light for power purposes in Paris are a syndicate or rather a company controlled by the house of Rothschild, so that there is every guarantee in the world that when that thing is undertaken it will be done thoroughly, and no doubt successfully. I am now tempted to refer to something that has been upon my mind for quite a time, and at the end of this discussion I feel inclined to bring it before you, not in the prophetic spirit to which you have been inclined to attribute most of my addresses, but because it seems to be the solution of the distribution of power in the city of New York, in which, as Dr. Wheeler has said, more business is done in a smaller space than in any other spot on the face of the earth. The subway commission have undertaken a great task, and as far as they have gone they have done it as well as the present state of the art will permit. That is a meed of praise I think we will all accord them. But I am tempted to think of an anecdote which Mr Barnum relates. I do not intend by quoting it to cast a reflection on the subway commission. Mr. Barnum says that in his experience one of his friends got married and received a present of a very magnificent velvet sofa, very comfortable to lie on but not at all in keeping with the length of the young man's purse. He did not have it long before it was found necessary to change all the furniture in the parlor. That necessitated a change of all the furniture in the dining room and that was followed by a change of all the furniture in the bedroom and the whole house, and if it had not been for an unexpected run of luck that young man would have been ruined by his sofa. Now several people have acted in such a way as to furnish a magnificent conduit. It will be furnished and the fruits of it will be enjoyed as this young man did through his unparalleled prosperity, and electric power will be distributed through the ducts now in the city under the control of the subway commission, and it will be a success. But I will suggest that it may be done most advantageously in this way: If we look at the supply of light, water and steam that we have in New York, we find that everything is distributed from a central point at an equal pressure. If we were to use the Forty-second street reservoir to-day people would say it is ridiculous, because we have a higher source of pressure. It is an idle thing which I might like to see turned into a library some day. The reservoirs in the park are ornamental lakes sometimes, but even they might be done away with. We might go to High Bridge and put up standpipes as they have done there and get a uniform pressure. The only thing necessary for the distribution of power to make it available to every consumer is a constant source of pressure and an unlimited amount of power. How are we going to accomplish that? If we look at these subway ducts we will find they are not as in the human body—every artery, every vein, every nerve connected with some simple point of uniform distribution and pressure, but we find through one orifice is to go a power, say of 100 volts, through another one of a thousand volts; through another of two thousand; through another one of ten thousand; all acting by various inductions upon each other, interfering with each other, and really giving you no means by which, if an error or a waste is introduced, it can be interrupted without in some way affecting the other potentials. That introduces an element of variation which is to be avoided. How then, can that be done? In the present state of the art it is as easy as furnishing a mild current of water for washing the hands or a powerful one to the bath tub or one still more powerful for taking the shingles or slates off a roof by means of the steam fire engines, all from the same source of power. But we must be able to distribute from a constant source of electrical power potentials of any height. How is that to be done? It may be done in such a way that the original source can be entirely safe-guarded. My friend here speaks of the conduit as a success, but he has nothing to put into it. Why? Because insulation has not been carried to that point of protection. It is wearing out all the time. Now then, we must have a conductor of such character that we can say when it is put down it is never going to be touched; it is a constant source of power, as regular as the sun for its heat, and there it is to be disturbed and changed into any condition that we desire. How is that to be done? Gentlemen, it is done partially for electric lights to-day. You will find conductors, particularly in Pittsburg, where I saw them very extensively distributed—conductors of very small dimensions going through the streets carrying one or two thousand volts, and then being distributed in potentials of fifty volts. I would like the ducts of the subway commission built with a series of conductors, all electrically connected, and having a potential great enough to enable all the force that is necessary to be distributed through this vast metropolis, and be permanently there as a source of supply without in any way seriously incommoding our streets. All the current necessary to run all the machinery of the electric light, telegraph, telephone, burglar alarms, and so on could be carried through a conductor one foot in diameter, that could be laid through the streets of New York. It could be so carefully insulated that not one hundred-millionth of it would be wasted. It could be made available at any spot in the smallest quantity and in the largest. Let any accident happen to any piece of machinery, and it would be unable to interfere with the enormous power behind it. There must be nothing to interfere with the great current of force that should circulate through the city. That to my mind is the beau ideal of the distribution of power. Now, then, how to do it. We are stumbling upon a thousand difficulties, but I think they can be arranged. You have interests of various kinds—electric lights, power, and so on, all of them running antagonistically. How can they be persuaded that such a system as this is best? Simply by showing to them that they may unite their forces for the furnishing of this power. You cannot put up in any one place a station that would be sufficient to supply the whole of it. It should be like a series of ganglia pumping into this great main artery the power that is necessary. Let them all pool their issues and pump into one station, and from that point let it be distributed, if you please, by the underground commission or by any one who will take charge of it. Let the source of power distribution be the essential feature. It is immaterial to me whether the power is used for lighting or another purpose; power is at the bottom of it and power should be furnished in the most equitable and most useful way.

Now that is not by any means a Utopia. It would enable you in the smallest area to safeguard your current in such a way that it would not be interfered with by any other interest. It would be distributed through all the streets of the city just as water is. It can be done, and in a very much easier way than people imagine. Gentlemen, to my mind that seems to be a solution of this whole difficulty. Of course for minor distributions that can be very easily accommodated, because between any two blocks you have but a small sub-distribution to make. That can be easily accomplished. Transformers of current can be put everywhere and anywhere and attached to that main source of supply and measured in the simplest way possible, without any danger. We would have arc lights in our houses then. Do not think, gentlemen, that I am trying to derogate from the importance of the arc light interests. People, instead of having arc lights in the streets, would be satisfied to bring them into their rooms if they knew there was no danger. Transform your current from one of two thousand volts into fifty volt currents, and you will find your interest will be tenfold magnified inside of a year. Gentlemen, I have nothing further to say, but give you that to digest. (Applause.)

Mr. DeCamp: The remark of Dr. Moses led me to think that I might have been misunderstood. I believe with Dr. Moses that almost anything is possible. I do not by any means wish to convey the impression that we will not reach this very desirable end. While I do not propose to be a skeptic in this matter, yet, on the other hand, I do not propose to be an enthusiast. I cannot discuss that question nor will I undertake to discuss it from the point at which Dr. Moses and many other gentlemen in this association are entirely competent to discuss it. That is not my line of business. I am simply a man in the business who has to look out for the financial interest of my principals. I have got to see that their investment is properly made and reasonably remunerative. The chairman asked me to make some figures, and I submit them, knowing that figures not supported by data are dangerous things to deal in; but I want to submit them and take the risk, depending upon the good judgment of the members of this association who have experience in that line to believe that I am conservative in regard to these figures. Eight hundred dollars a mile rental for the use of conduits—not the furnishing of wires and circuits. Eight hundred dollars a mile for a cable or line which cost $500 a mile. Now the gentlemen who framed

that schedule must have had in their mind's eye a wonderful depreciation to ask more than 100 per cent. on their investment the first year; but admitting that it may be justified by something of which they are the most competent to judge, my experience in the conduct of an electric light station is that it is a pretty difficult thing to distribute more than fifty lights in a circuit of two miles. We do not do it in Philadelphia.

T. CARPENTER SMITH: I would like to ask if that $800 rental refers to the ducts or to a single wire?

MR. PERRY: It was stated that it was a single duct, $1 000 a mile for a single three-inch duct.

MR. DECAMP: Provided you can use it for general public lighting.

MR. SMITH: Suppose Mr. DeCamp keeps to the conditions that apply to the cable now put in

MR. DECAMP: That is a thing in which you might do yourself injustice. I will come to that point before I get through, but take out the general city lighting; that means two hundred miles of wire; that means forty cents a light. Now to answer this question on the basis on which the gentleman raises the point, it is true that it does not follow that our mileage should be the number of lamps multiplied by two miles, because, certainly as a matter of economy in rental we would use the same duct, where we could, until we got it full. Now to what extent you could do that is a matter that is only guesswork. But I cut it in two—divide it by two, if you choose, and pay $80,000 rental a year for a thousand light station, and figure out where your dividends would come from.

MR. APGAR: May I offer a suggestion here? Could Mr. DeCamp reach the conclusion he seeks—I see what he is after—by ascertaining what it would cost to put the whole plant with which he is connected in the ducts furnished from $550 per mile per year to $1,000 per mile per year? He knows how many miles he has in circuit, and he can determine what would be the annual expense for rental by placing all of these wires in ducts. You could reach that quite readily, could you not?

MR. DECAMP: No, I could not do that quite readily by any means. If I were going to put our wires in a conduit for which I was paying $800 per mile rent, I would do it in a very different way from what I am now doing it.

THE PRESIDENT: On this basis the gentleman means.

MR. DECAMP: Any one who has had experience in distributing light from a central station knows that his first calculation of the first cost is apt to be deceptive. We run wires from our central station, not with the view to supply the particular lights we may run it for at first, but we run it over a district, if we have the privilege and opportunity of doing it, by which we think we can utilize that wire to the best advantage. In other words, we might go to get ten lights, in a direct line of a mile, if the ten lights were our only object. Very probably we would choose to put out five miles of wire over a territory from which we would draw other business. Therefore, for me to make a statement on the basis of the wires we have got would be more uncertain than the figures I have already stated.

MR. SMITH: Mr. DeCamp has made one statement which I think is entirely right, that this question of underground wires has been taken at the wrong end, but I do not agree with him as to the way in which it has been begun at the wrong end. I maintain it has been taken at the wrong end because the men who have been getting these various reports on underground wires are the men most directly interested in underground wires not being a success. We are told over and over again of the failure of underground systems, and it reminds me of the old story of the man who had stolen the cow. One person was produced who saw him do it, and he replied that he could bring forward twenty men who had not seen him do it. I maintain that in a case of this kind one good instance of successful work is worth forty instances of bad work. When Mr. DeCamp states that there is no successful underground work in Philadelphia, I think he must have forgotten what I told him in Pittsburgh, that I had fifteen miles of wire running underground in Philadelphia without any trouble. We supply eight newspaper offices, and I think any one who has ever supplied a newspaper office will agree with me that they are the hardest to please of all our customers. Those eight newspaper offices have cut off their gas entirely and are entirely depending on our supply. We are using 1,000 volts of alternating current. We have never taken out a single cable but one. That was a small piece of double conductor No. 10 wire which we pulled out owing to a short circuit having taken place in the cable itself, and we had the lights running again in six hours.

A great part of Mr. DeCamp's speech was taken up with what seemed to me to be simply an attack on the Subway commission in this city. Now, with all due deference to the Subway commission here, I do not see that their action in this city has very much to do with the convention. It is very hard on electric light companies, I grant you, to have to pay any such rental as $500 per mile per year, but Mr. DeCamp has been very anxious to know what it is going to cost to put circuits underground. I have laid altogether somewhere between five and six miles of underground work in a sixteen duct box, fitted up complete, with three manholes to every square. Counting everything from the digging of the trenches to the repaving and giving bond to the city, will cost him about $7,000 a mile. That does not include the cables to be drawn in He has made the statement that matters of this kind are put in the hands of men to legislate upon who know nothing upon the subject. Very true, I happen to know of a commission that is appointed to examine into the question of underground wires, who came to a certain city where there were a number of arc lights which were reported to be running satisfactorily by the man who was operating them; where there was an incandescent station operating from 2,200 to 2,500 lights on underground wires, running for two years without any trouble, and a gentleman who had a large arc light station in that town got hold of that commission, took them around in carriages to the park and to the theaters, and that commission went away without seeing a foot of underground wire, and I have no doubt made a report on it. That is a good way to help people who are ignorant of the subject to find out about it. But it is hardly the way a business man would go to work. I am afraid I may be looked upon as a crank on the subject of underground wire. I have put money into a company which has to use underground wires for the reason people have got all the overhead privileges in the town and will not let us get any; consequently, we have to go underground. (Laughter.) There is some advantage in starting out in knowing just what you have got to do. You know you have got to spend your money, and you are going to take the best care and to get the best work; but the man who has already spent his money, of course naturally objects to taking that all out and starting on the same ground as we have. With regard to the whole question I wish to say a few words upon the results of some patient investigations on my part. I would say that the whole question of underground wires has not been attacked in the right way. The first question is, how are you going to distrbute the currents? The second is what effect are your methods going to have on the public? Now it seems to me any system that involves the laying down of enough conductors to supply the business you have in prospect in the next twenty years is a mistake. There is a company in Philadelphia now which has stated that they have spent $250,000 on the copper in the mains in that city covering a district two miles long and a quarter of a mile wide. They say they expect to put fifty thousand lights on those conductors, and I guess they may get them in about twenty years. If instead of that copper which by advance in our knowledge may be rendered entirely useless in the next five years, they had put that money into conduits it would not have cost them anything like that amount. Now, if we start with the idea that we must not have our conductors buried—the actual metal required buried at once—it seems to me that the only thing we can use is a conduit that will allow us to increase by drawing in cables. We know what a conduit will cost. The greatest expense in a conduit is the trench and the repairing of the street afterward. That would amount to anywhere from 35 to 40 per cent. of the total cost. If you put down a conduit into which you can draw additional cables afterward, you are saving as much as possible of the original expense; not only that, but you are getting rid of the greatest opposition to the underground system—the objection of the citizens to having the streets torn up every time you have a break or want to make a connection. At present all the people in the electric field have the misfortune to be damned by the newspapers for not going underground, and doubly damned by the people for tearing up the streets to do it. We reach the point that you must have a drawing-in conduit, and the next thing you must have is the means of distributing the current to every house in the block without digging up the street. That can only be done it seems to me, by having a small distributing conduit running alongside your trunk lines to which you can make your connections the same as you would with a water pipe or gas pipe. The people will make no objection to that. There are such systems; there are dozens of them, and it is not so much a question as to which system you will adopt as that the work should be carefully and honestly done on the start.

The arc light question is one which, practically, I know little about, but we have heard this morning from Mr. Acheson that the great trouble from the puncturing of the cables evidently arises from the static charge. Now, in an arc light circuit, it seems to me that static charge would only arise at the moment of opening and closing the circuit or at the flashing of the machine. In an alternating current, with which I understand Mr. Acheson made his test, the charge is there continuously, as it were. I have noticed on an arc light circuit a peculiar condition that took place where I was using a couple of ordinary Thomson-Houston lightning arresters on the ends. Every time we opened and closed the circuit we would get a spark across the lightning arrester, and on a night when the machines were working badly I have seen a continuous static spark running across, but I never thought that was a solution of the matter until I heard Mr. Acheson's paper.

Now, I have noticed rather a curious thing that occurred on our circuits with the alternating current machine. We had three armatures give out without any sign whatever. They tore all to pieces. We examined them as carefully as we could and came to the conclusion that there had been a short circuit in the wire of the armature itself. The men told me that regularly for two or three days before the armatures gave way they saw the sparks on them. Owing to one of these break downs we had to overload a machine one night, and one of the men told me that that machine was sparking. I found a little spark jumping from one of the pole pieces into the armature, a very bright little spark. I came to the conclusion that it was the charge in the belt. The machine was insulated on a good dry floor. I ran over to the ground detector and I found a slight leak on one of the circuits. I concluded that that was a static charge from the belt. I threw a little of the load off the machine, and the spark stopped jumping. I put combs on the belts and we have had no more sparking of that kind. I examined that armature and I found that the mica covering the wires was punched, and that is satisfactory evidence to my mind that the spark went through there continually. Now I have had the same thing occur on the line where there is a constant sparking from opening and closing the main circuit where the spark would jump through anywhere from five to six inches, and finally burn right through the insulation, then we would get grounds and we would find a little hole burned through. When the convention met in Pittsburgh last spring, I told them I had a good deal of cable out there on the Monongahela bridge running electric lights. I had in there two 0000 cables, eighty-five to ninety amperes. Those cables ran with perfect satisfaction save one burn-out occasioned by lightning. It fused the copper wires of the conductor together. A piece of three or four inches was burned out, and the cables have run all right since But a little cable we put in there had a very curious experience. The question was raised whether putting lead covered cable into a creosoted box would not cause the lead to be decomposed, and the proposition was made to cover it with some sticky tar compound. I thought I would improve on that by covering the cables with a braiding, and saturating that. I put the cable in and told the men to ground it thoroughly. The first night that ran we punched seventeen holes in it. I spliced it up and went ahead, and the next night it broke out in three places, and I found that the men came to the conclusion that as it was so nicely insulated it did not need to be grounded. We grounded it and that was the end of the trouble. The cable had been ruined, however, and we took it right out. I examined it, and in a great many places there were no sign whatever of injury to the cable, but the lead was melted right out, and had run away. I supposed that was due to the static charge escaping at that point. I do not know that I need say any more. If there are any gentlemen who have any questions to ask about what success we have had I should be glad to answer them. For the arc light side of the question I would call on Mr. Sunny. I should like very much to hear from him now as to what his experience during the last six months has been with the additional light he gained at the last convention.

THE PRESIDENT: The chair is compelled to call the discussion back to the main point. A good deal of irrelevant matter has been thrown into this discussion during the last hour. The point about it is this: The subway commission came through a representative before this convention with certain statements. Practically they amount to this: That they are putting down a conduit system, that they have not a single arc light wire working through that system, but that they hope to by the first of October. Is that it?

DR. WHEELER: A good deal before that.

THE PRESIDENT: Then elaborated the plan, and so on without the cost being given.

DR. WHEELER: Pardon me. I do not think that statement is so—that no cost is given. As I understand it the cost is given to persons who come and inquire for it in the proper way. That is one of the statements which Mr. DeCamp made in his first speech.

THE PRESIDENT: The gentleman will pardon me when I say that the question was asked here, what it cost per mile of conduit, and there was not a man on the floor of this convention who could answer it. I am taking it on the basis of this discussion. In the paper itself, there is no cost given per mile. It is eliminated at the present time from the discussion. The commission says: Examine the way the wires are put in and form your own judgment and we should like it if you gentlemen would make any suggestion that would help us. Now if there is any gentleman who has any suggestions of that kind let us hear them, and discuss them. If there is any question to be asked these gentlemen who are laying this conduit, let us get that before us and go into the meat of the question and take up the general discussion afterward.

DR WHEELER: I would say that I think there is no question about the fact that putting wires underground is a matter of considerable expense. I did not attempt to give the explanation in my paper, because there is no doubt about that fact and as to the inquiry as to what the expense is, Mr. DeCamp says I replied I did not know and that Mr. Leslie replied he did not know. I replied that Mr. Leslie was the proper man to answer that question and I think Mr. Leslie said that the proper way to obtain an answer to it was individually to make that inquiry at the office of the company. I do not think it is correct to state that Mr. Leslie and I said we did not know what the cost was.

THE PRESIDENT: We are going back to the main question. These suggestions that are made on the floor as to the cost did not bring out the answer That is not before us; therefore we cannot discuss it. Now Mr. Kinsman has the floor.

MR. KINSMAN: I wish to ask what was the size of the conductors through which he was sending one thousand volts of current so successfully.

MR. SMITH: All the way from 0000 to number 16 Brown & Sharpe gauge—from the single conductor down to double conductors in the same cable. Excuse me, we have one conductor, three wires in the cable, number 18, Brown & Sharpe gauge, running very nicely,

MR. KINSMAN: What is the length of the longest cable?

MR. SMITH: We have altogether about fifteen miles in circuit, but it is so cut up we cannot give any straight length. The longest direct length is 2,000 feet without a break. That is cable that was made for the alternating 1,000 volt circuit. The longest single length of cable intended for 200 volts runs up to about half a mile.

MR. LYNCH: I would like to ask Dr. Wheeler if the commission have adapted as the form of conduits, an iron pipe covered by hydraulic cement?

DR. WHEELER: They are authorizing the building of that kind of conduit. I do not know whether you can say they have adopted it or not. It depends by what you mean by adopted.

MR. LYNCH: Is there any other city where the same kind of conduit is being used?

DR. WHEELER: Yes, they are using them in Chicago. In Chicago they had a conduit made of creosoted wooden tubes, in which they tried an arc light wire The arc light wire set fire to the conduit, and they tried to put out the fire with chemical engines. That did not succeed, and they squirted water into it from a steam fire engine, and kept that up for about a week. They found they could not put out the fire apparently They took that conduit out and replaced it, I understand, with iron tubes laid in hydraulic cement.

MR. LYNCH: How long has the iron conduit been used there?

MR. SUNNY of Chicago: I can answer that. The Dorset conduit was put down about seven years ago. This creosoted conduit had been down only about two years It did not take a week to put out the fire, but we could not get at it for some days. We stopped up both ends, and thought we would smother the fire by depriving it of air. When we were able to get at the creosoted wooden box, we took it up and put down iron pipe in its place. The length was about 105 feet, and the conduit consisted of fourteen ducts of the creosoted wood We put down some sixteen of the iron pipes in its place. There are no

manholes The telephone company at Chicago has a system of conduits made of iron pipes in cement, the same as is being put down by the Subway commission in New York now.

MR. LYNCH: Dr. Wheeler, has this Johnstone patent that you speak of as being recommended by the subway commission for supplementary batteries, been in operation in this country?

DR. WHEELER: That has been in operation in Philadelphia and Chicago.

MR. LYNCH: But as I understand Mr. DeCamp there are no electric light wires in it at all?

MR. DECAMP: It is used now for an incandescent station: The arc lighting business was abandoned about a year and a half ago.

MR. SUNNY: Well, I ought to state in addition that at all the street crossings, where we want to cross from one side of the street to the other, the conduit is all iron pipe Then we have added within the past two or three years a considerable length to the original Dorset conduit and put it in iron pipe.

MR. LYNCH: What do you use in the form of supplementary ducts in Chicago?

MR. SUNNY: I scarcely know what you mean by that.

MR. LYNCH In New York they have a main line of conduits running straight through the streets. Entrance to the conduits is through the manholes, which are at every corner.

MR. SUNNY: You understand that in Chicago the sidewalks are all hollow, and the main line of conduit is built along the street the same as in New York-from the manhole. We have what we call laterals running into the four corners of the intersection. We carry our cables in there and then along under the hollow sidewalk cutting loops for each subscriber as the service may demand it; so that the question of the distribution of power and light is an exceedingly simple one in Chicago, which is probably the only city that is so fortunately situated.

MR. DECAMP: I want to correct a wrong impression on the part of Mr. Smith, and perhaps on the part of others. In my statement that there were no light wires underground in the city of Philadelphia that were being successfully operated, I referred only to arc light wires. I think his honor, the mayor, is entirely correct, that enough has been done in the way of operating incandescent or low tension current to justify whatever doubt there may be in regard to it being resolved in favor of success Mr. Smith, in Philadelphia, is using a current of 1,000 volts, and at the February meeting in Pittsburgh I inquired particularly about that, because it was a matter of interest to me at that time. I learned from Mr. Smith direct that there was a good deal less difficulty in insulating for that 1,000 volts than there was for a constant current of 2,000 volts. I went no further. Another thing. I disclaim any intention of making an attack on the Subway commission of the city of New York. I think they are making a great many mistakes. I have a perfect right to think that, but I have one single suggestion to make them, that they go to work and secure an insulation—which has been suggested from time to time and to-day most forcibly by Dr. Moses—that will stand the currents that are used to-day for general, public and commercial purposes. Let them provide at the same time for the excess. The standard to-day for that kind of work is, say 3,000 volts. Treat it exactly the same as you would treat a steam boiler that you want to carry 100 pounds' pressure; have the initial test made at 150 pounds. In securing your insulation for 3,000 volts give it the benefit of fifty per cent. increase. When you have secured that insulation, then is the time to take up the question of subway, the question of conduits, the question of distribution. That is what I have to suggest to the Subway commission. I would like also to make this suggestion: Is there a gentleman on that Subway commission, or on the floor of this convention, who is prepared to say that when they accomplish the object I suggest that their whole scheme and system of subways will not be found to be entirely useless. The calculation of eight wires to a duct to-day is based on the insulations of to-day. If it is necessary to double or treble that insulation in order to secure it, it reduces the capacity of that duct to one-half or less. By the time they get through with that insulation perhaps they will find the whole thing useless, and they will have to have some other sort of system. Therefore, I think the time and money, to-day, on the subway conduit is wasted.

MR. SMITH: Mr. DeCamp says that I stated at Pittsburgh that it was easier to insulate a thousand volts alternating than a thousand volts direct.

MR. DECAMP: No, on a current of two or three thousand volts

MR. SMITH: I simply said at the Pittsburgh convention that our company had succeeded in insulating a thousand volts ultimately.

MR. SUNNY: I should like to add something to what I said at Pittsburgh relative to the underground experience at Chicago As you all know, all of the arc light business at Chicago is being done through underground wires. The electric light companies never had any poles or wires in the streets, so they never have been in the position in which the electric light companies in New York and Philadelphia are to day. They started out with underground wires; they never had any other method of doing the work, and have had to do the best they could with the underground problem We have done a great deal of work in that direction; it has been interesting, but it has been very expensive. About the latter part of last year all of the smaller companies were organized into the present company, the Chicago Arc Light & Power company, and a new central station was built into which all the circuits were carried. The conduit is filled up with wires insulated with okonite, having an insulation of about 3-32ds of an inch These wires were not used more than thirty or forty-five days, and were then abandoned, because they burned out, but I ought to say in connection with that, that it was not a fault of the okonite insulation; that company furnished those cables on the express understanding that the conduit was a perfect insulator, and that even a smaller insulation would have been large enough to carry the current of 2,250 or 2,500 volts. It was thought, after those cables burned out, that something to protect the insulation ought to be provided, and lead cables were selected having an insulation of the same size as the okonite—3 32ds of an inch. Those cables lasted about sixty days, and in January we had to pull out something like forty or fifty miles of them and throw them away. Then we put in cables covered with lead, having an insulation of 6 32ds of an inch. This is a paraffine insulation. The cables of 6-32ds insulation have been in service about seven months. So far we have had four interruptions; that is, four grounds have been developed in those cables. We have about thirty-two circuits, carrying about 1,200 lamps. We have had four cases of trouble in those large cables Of those four cases, two have occurred in the Pittsburgh cable, and two in the Western Electric cable. We have been able to get at two of these pieces, one of the Pittsburgh, and one of the Western Electric. We find that in one case the burnout was caused by mechanical injury, and in the other by a discharge between the lead and the copper. The other two cases we have not been able to get to, and we do not know whether they have been caused by mechanical injury, or by the heavy current

While we do not feel that we have solved the underground problem, we feel that the last six months has indicated that we are on the right track, and we are very hopeful that we have succeeded in finding a cable that will carry the current and give us permanent service.

With regard to the cost, I have made a few figures that are very nearly correct, based on the experience that we have had. It costs us about $1,500 for putting in one circuit for two miles, one mile out and one mile back. That $1,500 includes the lead cable and the lamps. We are able to pull three cables into one duct of the conduit, and the charge for rental is $1,000 per mile per duct, so that each wire has to stand its proportion of the expense, which would be $333 a mile a year. Now it is very hard to tell, I cannot say with any degree of confidence, that those cables are going to last five years. They may last ten or fifteen; perhaps they will last one year. We know nothing about that. But if they last five years we will have paid in rent $3,330, and the original expense of the cable of $1,500, a total of $4,830, which is $20 per year per lamp. I do not know what it costs you for aerial lines, but I think that you can count on a cost of from $18 to $20 a year per lamp on underground work. (Applause.)

MR PERRY: If the president will kindly permit me, I would like to ask the gentleman if he is making any extensions of the Dorset conduit?

MR. SUNNY: No, sir, we are not.

MR. PERRY: When you extend your conduit system, what do you use?

MR. SUNNY: We are using iron pipes, for the reason that our extensions are very small, and it is handy and quite inexpensive to put down. But if we were to make any considerable extension we would use cypress pump logs.

MR. PERRY: You are not afraid of their getting afire again?

MR. SUNNY: No, I am not afraid of that, because they become soaked with water.

MR. PERRY: Where you put three wires in a duct, do you put in positive and negative?

MR. SUNNY: We did put them in indiscriminately last year, but in putting in the new cables we put the positive wires in one duct and the negative wires in another.

MR. PERRY. Where you cross the street, do you use the concrete around your single iron duct.

MR. SUNNY: No, sir. I would like to say in connection with Mr. Acheson's paper, that we were very much interested, as you can readily believe, in finding out why it was those cables burned out. When we selected a 6-32ds insulation to substitute for a 3-32ds insulation we did not know just why we did it, but we had to do something, and we thought a if 3-32ds would burn out and 4-32ds of which we had a little would not burn out except on rare occasions, that if we took 6-32ds we would be pretty safe, so we took 6-32ds and we have only bad four cases of trouble. I made some experiments three or four weeks ago and I am sorry to say that I cannot fully agree with Mr. Acheson in his explanation of why those cables burn out. As I understand it his theory is that where lead cable is used the dynamic current passing through the copper conductors generates a static current in the lead, and after enough has been stored up in the lead a discharge takes place which is general through the insulation puncturing the cable. The experiments that were made were these: We spread out a piece of lead covered cable on one of the floors of the building This cable was 950 feet long. We connected it to one of the arc circuits, making it a part of the circuit. We connected the lead which, understand, was perfectly insulated from the earth and from the proper conductor—with a condenser, and then discharged the condenser and got a spark about 1-64th of an inch long, which evidently would not jump through the insulation we have in use. We found on examining the condition of the circuit on the outside with which this piece of cable was connected, that the insulation was something like a megohm. Then we took this piece of cable off the outside circuit and put it on what you might term an idle circuit where the insulation may have been about five megohms. We found that we got no noise and no discharge from the lead. The conclusion we reached is that if the insulation on the outside is gotten up to a point above a megohm, there is not any danger of the lead cable; that there is no static electricity generated in the lead; but that if the insulation of the lead cable is low, if it is down to 250,000 ohms, which is practically a ground on one side, you get the thumping of the dynamo trying to reach a ground ahead of the resistance of the lamps on the other side.

DR. WHEELER: I would like to ask Mr. DeCamp what he meant by stating that the problem is not one of subways but of finding something to put in them, and if he meant that insulation could not be found, as far as he knew, which would answer in the subways. I would like to ask if the experience related by Mr. Sunny would answer his question.

MR. DECAMP: No, sir, it does not answer it. I refer entirely to the difficulty of insuring an insulation that will stand the current it is necessary for us to use to carry on the business that is now conducted; that is a high potential current. I do not consider that that has been done successfully. When I say successfully I mean commercially successfully. Mr. Sunny is very fair in his statement. He tells you that he is not prepared to say that the last seven months' experience is evidence that his last effort is a success. Certainly his former efforts were not successful because he pulled all his wire out and put in new wire. Now do not make any mistake about it, because when you get that insulation, and if you and I live long enough we will probably see it, you will very likely find that that all the provision you have made by these subways is entirely useless for that particular kind of wire.

DR WHEELER: But don't you think that in view of the number of grounds they ordinarily have on overhead wires that an experience of getting only four grounds on a large number of circuits is very satisfactory, especially for a place where this work has been tried for the first time?

MR DECAMP: When Mr. Sunny says the first efforts were made seven years ago you know he is right on deck with the overhead wires, because that is about their age. I would consider four grounds on an underground cable equal to 400 on an overhead wire, because the latter is simply a matter of a few minutes,

DR. WHEELER: It depends a good deal on whether you are looking at it in the light of public safety or in regard to keeping the light burning.

MR. DECAMP: That is the only thing that his honor omitted to state yesterday with his usual clearness. He quoted to you the statistics as to the danger of electric light wires. It is so infinitesimal as compared with that of any other industry that I do not think it is creditable for us to discuss it; but the question is a very serious one, when you get all your wires underground, whether wherever they do come above ground the danger is not very greatly increased.

DR. WHEELER: No, because the length of wires exposed, from which people get shocks, is very much less.

MR. ACHESON: I would like to ask Mr. Sunny what he refers to when he speaks of the noise that he heard in the cable—the thumping?

MR. SUNNY: I ought to have explained after we discharged the current into the condenser and then discharged the condenser, we connected a telephone into the lead on one side and a ground on the other and listened to the racket make by the Thomson-Houston machine. We got a tremendous racket When there was practically a ground on one side of the outside circuit, we could hear the noise for a distance of fifteen feet, but when we put this piece of cable on the house loop the noise was practically nothing.

MR. ACHESON: It is quite evident that the difficulty he found in obtaining a spark was due to the want of a charge. You cannot get the discharge until you first have the charge, and the fact of his obtaining no noise was an evidence that there was no charge formed. If there had been a charge formed you would have heard it through the telephone.

DR. MOSES: Will Mr. Sunny please explain to us the data once more so that we may be able to judge for ourselves whether there was a charge or not? Will you please tell us what the object of the experiment was, and what the conditions were under which the experiment is made?

MR. SUNNY: The conditions were simply these: This piece of lead cable 950 feet long was strung out on the floor. The floor was perfectly dry so that the lead was well insulated. We connected one side of the lead to one side of the condenser. The other side of the condenser was connected to a copper conductor; then we discharged the condenser and we got this spark of about 1-64th of an inch.

DR. MOSES: It seems to me from the conditions of the experiment that Mr. Sunny only put together a rather elongated Leyden jar. The superficial area of the lead envelope was the equivalent of the exterior coping of the jar, and as it was laid out on a dry floor it shows that it was very well insulated and consequently not fully discharged itself, and that therefore be only got evidence from the electricity that had gathered on the exterior of the Leyden jar.

MR WEEKS: Mr. Sunny stated that the cables first put in have all been withdrawn. Can you, Mr. Sunny, state to the convention the loss to your company represented by that experience?

MR. SUNNY: I can only state the loss approximately. It is very difficult to arrive at any definite conclusion, because we not only lost the cables themselves, but the growth of the business we were sure to have We lost a reputation for service and we lost in so many indirect ways that it is very hard to determine just how we came out. I should say however, that the substitution of the cables, changing them three times, cost us about $50,000.

MR. WEEKS: How long had those original cables been in before they began to fail you?

MR. SUNNY: They were practically new. They were not in long enough to be at all acted upon by any excess of moisture under ground, and I think it was purely a case of thin insulation. They had not been in more than four or five days, I think. I was not connected with the company at that time, so I cannot answer that question positively.

MR. WEEKS: I believe that you stated that these cables have now been in service about seven months. What is the insulation of your circuit by your daily tests? When I visited your station last I found that about 80 per cent. of your circuits were disabled, through the fact that their insulation was so low that you could not run on them. I

think, if I remember correctly, some of them ran down to below 1,000 ohms.

Mr Sunny: I would like to ask Mr. Weeks about how long ago he secured this information.

Mr. Weeks: About six months ago you will remember, when I called at your office.

Mr. Sunny: I can answer that question better, I think, by quoting a remark that Mr. Haskins, the city inspector of electric light, made a few weeks ago. We send him a report every Monday morning showing the insulation tests of our circuits, taken the day before. He has kept those reports, and he says he sat down and figured them up for several months, and that the average insulation of all our circuits was 550,000 ohms; that those tests were taken on dry days, wet days, and in all kinds of weather. The tests were invariably made Sunday morning at about the same time, without regard to the condition of the weather. His figures were based, therefore, on an average running all the way through, and I think that it was a very fair average. Our circuits now measure a megohm in fully 95 per cent. of the cases. I do not know how much higher they measure, because that is the capacity of the galvanometer used for that purpose. If they are a megohm we are satisfied. If they are below that we "go" for them. We have still some okonite and kerite and bitite and other "ite" wires in service, and the low insulation comes in in those wires becoming soaked with water and crossed with some metal or stone sidewalks.

Mr. Eustis: Is that insulation for a double circuit?

Mr. Sunny: That insulation is for a double circuit. There are 32 circuits; none is less than two miles and some of them are five.

Mr. DeCamp: You spoke of average insulations? Do you make your reports on an average?

Mr. Sunny: No, sir; we report the actual insulation.

Mr. DeCamp: It occurred to me that that might be misleading. For instance, you might have one circuit with the insulation exceedingly high and two with it away down below the average, while the general average would be fair.

Mr. Perry: Has there been any deterioration from the time you first placed these cables in your box to the present time? Have the cables individually, each one, held up to full standard, or has there been some deterioration?

Mr. Sunny: There have been no changes in those cables with the exception of the four cases of trouble I have referred to. The insulation holds up first class. With regard to grounds coming in on these cables we do not look upon that as half so serious a thing as Mr. DeCamp. When the circuit is started up it measures a megohm or more. We do not know that the circuit is grounded until three or four hours before the next run or the next morning, so that that ground has not interfered with the service at all. Before it is time for that circuit to start up again we have cut in a new section of cable to take the place of the defective one and are ready to start up without any loss of service. The expense of a case of trouble is the labor of pulling out a piece of cable and putting it back again. Under the manufacturer's guarantee we get a new piece of cable to take the place of the defective one. That guarantee is for three years.

Mr. Perry: At the end of that time you will pull them out at your own expense.

Mr. Sunny: I hope not.

Mr. Perry: I must say that notwithstanding the fact that Chicago has been laboring so successfully with this matter for seven years, and notwithstanding the fact that they have for the last seven months been operating beautifully, this thing is not ripe enough for me to pick. I want to see him get over his troubles first.

Mr. Law: Mr. Sunny seems to think an underground wire is not a serious matter; we in Philadelphia have found it to be a very serious matter. I think when you have fifty or sixty lights burning a ground has been developed which may be in a section of wire one, two, or three miles long. It is a difficult matter to look at that ground in your length of wire and get it out. You perhaps start up that night with a ground on your line. About 8 o'clock at night, perhaps, the telephone rings and you are informed that the lights are all out on number 5 circuit. The horse is hitched up and you go driving out on the street, and you hunt for some time. You find the extremes of your ground, shut down your station and run a new line overhead between the lamps in order to make the connection. Your lights have been out all that time, perhaps one hour, two hours, or three hours, as the case may be. It depends altogether on how much time it takes you to put the wire up between the two lamps. Now I call that a pretty serious matter to have a whole circuit of lights out. Perhaps the whole circuit might not be out but a few minutes, but the lights between the two grounds are out all the time you are trying to get the circuit re-established. Now that was a matter that has happened to us, not once but several times. I have had lights out on one circuit varying in number from fifteen to fifty-three, for several hours during the evening, and the only way to fix those lights was simply to run an air line between the last two lamps. Fortunately the distance was not very great, and so we could do it very comfortably. Another section of cable two miles in length was grounded. In order to find that I had to make three cuts on that length of cable. I located the trouble in one length of 730 feet and procured a new cable. I pulled the cable out and found the burn perhaps 250 feet from the end, but in finding that I also found that the lead on the cable was so honeycombed that it would be perfect folly to put it back. Therefore I drew out the whole length of cable and put in a new one. In drawing that out there was perhaps fifty pounds of sulphate of lead that dropped in the manholes as we drew it out, showing the immense ravage that had been occasioned there. That cable had been underground about thirteen months.

Mr. Sunny: I do not wish to be understood as belittling the importance of keeping away from grounds or keeping them cleared up. Before we start out with our circuits, measuring the megohm, we cannot tell if a ground has developed on one side of that circuit unless the lights are reported out. I had reference more particularly to the four grounds in those new cables. In no one of the four instances did we lose any service on account of the grounds. It does not take more than an hour to change a ground on any one of our circuits. When we were having so much trouble, we would perhaps have eight or ten cases of grounds in the morning, but would generally have them all cleared up by three o'clock in the afternoon. We have a very good system, and so far as losing service on account of those grounds is concerned, we do not look upon that as a very serious thing.

Mr. Weeks: The question of the loss of service is not the most important matter in connection with the ground. It is tolerably certain to occur, however. You will lose your service; but there are other contingencies that may be very much more serious; for instance, fire caused by a second ground, or injury to individuals Our average insulation has been very much better than Mr. Sunny's in Chicago; but recently when we had a ground on one of our circuits it so happened that a citizen of the city made a second ground. The result is a $10,000 damage suit.

Mr. Smith: I would like to ask Mr. Law if the second ground, which cut his lights out, occurred on the underground cable or on one of the aerial lines.

Mr. Law: It occurred on the underground cable. One case was at 3 o'clock in the morning, and the other, if I remember rightly, about 9 o'clock at night. Our lamps are set on iron posts, with a wooden block on top to support the lamp. Under that wooden block is a terminal box in which the lead cable is inserted to protect the insulations of the lead cable. From that we carry out okonite wire to the lamp. A short circuit occurred in the terminal box between the wire and the lead, or between the wire and the case of the terminal box. In both cases it not only burned off the wires but burned off the wooden blocks on the top of the poles—in one case dropping the wires and everything into the street.

Mr. DeCamp: I would state for Mr. Smith's information that just before leaving home I noted on the daily record of tests on the line Mr. Law refers to, which is about one-third aerial line and two-thirds underground, that seven grounds were reported during the month of August, up to the time I left, which was last Monday. They were all on the underground part of the circuits. There were no grounds on the aerial part of the lines.

The President: The chair has given the widest latitude to this discussion, realizing that not only the gentlemen present, but the people they represent are vitally interested in this question, and not only they, but the people at large also, and the discussion this afternoon has been profitable in this respect. It has developed the fact that while in Chicago and in New York city and in Pittsburgh, Philadelphia and other cities they have claimed that there has been no progress and no effort made by the electric light companies to solve this question, yet it has been demonstrated that these companies, individually, working alone from their different standpoints, have each taken up this question and have attempted to solve it for themselves. They have not only done that but they have communicated one with each other and obtained the best information they could

When we first started to put up arc light circuits we had a wire that every one now condemns. We forced the manufacturers into making the wires we are now using, when we showed them they had to do it, and we will go on and show our vital interest in this subject by the appointment of these committees provided for in the resolution to-day.

This discussion has developed the fact that the gentlemen here in New York are going ahead with the best knowledge and the best intelligence they have at their command and they ask us as a representative body of men to start in and aid them as a body. We have never done that, hitherto, but in your resolution to-day you have provided for the continuance of the committee on the insulation of plant, and you have a vast amount of practical knowledge, as reported by Dr. Moses, to be collated and to be given to these manufacturers, and not only have improved the condition of insulation but secured improvement of the wire itself. You have gone further; you have provided for a committee of five, who shall collect data with respect to insulation from time to time and report at the next convention six months hence what has actually been done, what are the practical results, what has been the cost, what it is going to cost, so far as they can find out. We are in the right direction. That leads us up to another thing in my mind. It shows that you will need a permanent office, somewhere where you can get this information, where it can be furnished not only to the members of the association, but to the outside public and to municipalities and others who are clamoring for every one to go underground. I know if we could prolong this discussion we could get more valuable information; but it cannot be done with the limited time at our disposal, and these New York gentlemen are so exceedingly kind in their attentions that they practically take up half the time of the convention. Of course we are very thankful to them. At the same time that is the status of the case, and I am compelled to close the discussion.

The chair will name the committee on underground wire to-morrow morning. I will make one or two announcements. The first is that I shall appoint Professor Liebig of Baltimore in place of Professor Thomson on the committee on insulation and installation of plants. I want to say, gentlemen, just here that instead of members thinking it is no honor to be put on a committee of this kind, as might be inferred from the action of the committee hitherto in simply reporting progress, that I should regard this as one of the highest honors that can be conferred on any member; at the next meeting we will demand a report in writing from the committee, or know why they do not furnish it. They have reciprocal duties toward the association, and if they do not intend to perform them I wish they would so state when they are appointed.

The report of the committee on the constitution will be taken up

T. Carpenter Smith: I believe an explanation is always in order, and I wish to make an explanation to the members of the convention. In a letter which I wrote to a gentleman in this city, which was afterward read to the Board of Electrical Control, I made the statement that the inspector of lights in Chicago had shown a discharge from a magnet as an instance of an alternating current. I made that statement on the authority of a newspaper report of a lecture that he delivered. I received a letter from Mr. Haskins subsequently, imploring me not to put him down as an electrical idiot. I expected to meet him at this convention, when it was my intention to make a personal apology to him. But he is not here and I know of no other way than to make my apology in the presence of this convention. I withdraw the statement then in the presence of this association.

Mr. Mason, chairman of the committee on revision of the constitution, presented the appended, which, with amendments by Dr. Moses and Mr. Garratt, now stands as the revised constitution. The committee was discharged, with the thanks of the association.

Constitution.

Article I.

Name.

The name of this association shall be the National Electric Light Association.

Article II.

Membership.

Section 1.—Any individual or member of a company or firm operating an electric light, power, heat or welding station for public or commercial purposes; and any individual or member of a company or firm manufacturing electric supplies or apparatus, may become a member of this association, by the payment to the treasurer of one year's dues.

Sec. 2.—Electricians, electrical engineers, and those whose profession or business is directly related to electrical interests or to the commercial application of electricity, may upon the recommendation of the executive committee and a two-thirds vote of the association, become members thereof, by the payment to the treasurer of one year's dues.

Sec 3.—Upon the unanimous recommendation of the executive committee and the approval by a two-thirds vote of the association, persons may be made honorary members of the association, with all the privileges of membership, except the right to vote

Article III.

Officers.

Section 1.—The officers of the association shall be a president, two vice-presidents, a treasurer and a secretary, and an executive committee, to consist of the above named officers, *ex-officio*, and nine other members.

Sec. 2.—The president and vice-presidents shall be elected by ballot to serve from the close of the annual meeting at which they are elected, until the close of the next annual meeting.

Sec. 3.—No person shall be eligible for the office of president or vice-president for more than two successive terms, but this shall not be construed to forbid the election to the office of president of one who has served as vice-president.

Sec. 4.—The secretary and treasurer, who may be one and the same person, shall be nominated by the president, subject to confirmation by the executive committee. The salary of the secretary shall be fixed by the executive committee.

Sec 5.—The executive committee shall be chosen by ballot at each meeting, either annual, semi-annual or special, and hold office from the close of the meeting at which they are elected until the end of the meeting at which their successors are chosen.

Sec. 6.—The treasurer, secretary and executive committee shall make written reports at each meeting, which reports upon their acceptance, shall be spread upon the records of the association

Sec. 7.—The executive committee shall be the governing body of the association. They shall meet at the call of their chairman, from time to time, and shall report upon applications for membership, shall gather and prepare information upon topics of interest, and shall arrange for their discussion at the several meetings of the association. Five members of the committee shall constitute a quorum.

Article IV.

Meetings.

The annual meeting of this association shall be held in February, and a semi-annual meeting may be held in August of each year, at such places as the association shall determine, and such dates as may be determined by the executive committee.

Article V.

Dues.

The annual dues shall be $20, payable in advance, and shall cover the calendar year.

Article VI.

Ballot.

On any question before the association a ballot may be demanded by one-fourth of the members present.

Article VII.

Amendments.

Section 1.—Amendments to the constitution shall be presented in writing and referred to a committee to be appointed by the chairman before being acted upon by the associa-

tion; a two-thirds vote of those present shall be necessary to their adoption.

Sec. 2.—No amendment shall be voted upon on the day of its first presentation.

The convention then adjourned until the following day at 10 A. M.

Friday's Proceedings.

The convention was called to order at 10 A. M., by President Duncan.

THE PRESIDENT: We will open our proceedings this morning by taking up the reports of the various committees. In the absence of the secretary and his papers, I will simply state in a few words the report of the transportation committee, which was that they had made every effort to obtain a reduced rate to this meeting, but they failed in their efforts, although various promises had originally been made to them. They now have a letter, signed by Mr. Daniels, promising that if the next meeting should be held west of Pittsburgh, the association would give a one and a half rate for the round trip. That may be considered as the report of the committee on transportation, and the chair is now ready to entertain a motion to discharge that committee.

On motion, the report of the committee was received, and the committee discharged.

The President, on motion of Mr. Ridlon, appointed as a transportation committee for the next meeting, George F. Porter, Philadelphia, chairman; Morris W. Mead of Pittsburgh, and F. E. Degenhardt of Chicago.

The report of the committee on the New England insurance exchange was read by Mr. Ridlon.

REPORT OF COMMITTEE ON THE NEW ENGLAND ELECTRIC EXCHANGE.

I beg to submit to you the report regarding the New England Electric Exchange, as requested by the chairman of your committee, at the last meeting of that committee. This subject was first thought of and talked of at the electric light convention held in Baltimore in February, 1886, and has several times been referred to since, but only in March of the present year did it assume any business form. On the date referred to, the Boston Electric club sent out a notice asking the various electric light companies, or their representatives in the New England States, to meet at the rooms of the Boston Electric club, that we might discuss the relations between us and the New England Insurance Exchange, representing the insurance interests of the New England States. Added discussion of the difficulties then existing, or that might exist, between the electric light companies and the telephone and telegraph companies—these matters having been fully discussed in the afternoon and evening sessions—led to the formation of the New England Electric Exchange, which consists of a president, vice-president, and three directors. Since the first meeting, we have held one regular meeting of the exchange, on a date provided for in our constitution, and the president, secretary, and directors have met from time to time, to formulate a constitution and by-laws for governing the exchange, copies of which I submit, and appointed examining boards, for the purpose of examining applicants for licenses, and have now five boards, consisting of three examiners each, to attend to that part of the business. These examinations have been faithfully carried out, and some fifty applicants have passed the examination required, and have, or are about to receive their licenses for such a class of work as they are found competent to do. We have been ably aided by those whom we may now term our friends—the officers and members of the New England Insurance Exchange. They first encouraged us, by offering a reduction of insurance where buildings were exclusively lighted by electricity, and also where power was furnished from the same source. Lately they have issued a notice, stating that on and after the first of October, they would cease to issue permits for insuring buildings where electric lights were in operation unless the party operating the plants should hold a license from the New England Electric Exchange. In addition to this they are about to carry into effect a personal notice to all central stations, the same to be carried out in a personal interview between their representative, Mr. Brophy, and the party in charge of the central station, wherever the same may be located in the New England States. I believe that the success of this organization depends on the thoroughness with which the business as set forth shall be carried out; and that part having been accomplished in a thorough and satisfactory manner, it will not only advance the interests of electric light and power as a whole, but will free us from those petty annoyances and uncharitable remarks which are often given to different systems; being almost wholly brought about by want of proper care in constructing and maintaining plants. This may sometimes be due to carelessness, but more often it is a case of want of knowledge by the operator, who would gladly seek that knowledge, had be any means of obtaining it. As that knowledge has become a necessity, it would seem to be a duty for us to establish schools and places of instruction in our large cities, where intelligent workmen may seek and obtain the information they wish. This can easily be done in our electric clubs, where we have the books and periodicals, with everything relating to the rapid advance of the business. Also, able instructors in our members, who would be perfectly willing to devote one or two evenings in a week during the coming winter to the instruction of those who may wish to increase their knowledge of the business to which they intend to devote their energies. These schools, added to the scientific lectures and reading of papers on electrical subjects, which were so much credit to their writers during the past winter, will very largely aid in bringing forward our young men, and give them that practical experience, which, joined to the technical knowledge they may have obtained, would bring about that degree of perfection which would promote confidence with the insurance people as to the ability of those employed in electric light stations; and last, but not least, satisfy the capitalist that the money he has risked in carrying out electrical enterprises will be judiciously and intelligently expended.

MR. DE CAMP: I move that the paper be received and filed, and the committee continued, to report any further information they may get on the subject at the next meeting of the association.

The motion was seconded by Mr. Steuart, and carried.

THE PRESIDENT: The chairman will announce, as the committee on the resolution offered by Mr Lynch yesterday, to obtain practical information in regard to this underground question: Chairman, E. T. Lynch, C. H. Barney, H. Crocker, E. H. Davis, and Walter C Kerr.

MR. STEUART: Yesterday, at the close of the discussion upon underground wires and underground conduits, there seemed to be an absence of point to the action of the association, and some of the members considered that it might be well to put the matter into some definite shape, in order that the public might know what we did think upon this subject. I have, therefore, drafted the following resolution, and will offer it:

"*Resolved*, That the National Electric Light association, after a full discussion of the subject, desire to express their hearty sympathy with the views expressed by his honor, Mayor Hewitt, in his address before the association upon the subject of putting wires underground, and in addition, desire to take this method of expressing the opinion that, up to the present time, no commercially practicable method has ever been brought to their notice by which high tension direct currents such as are used for arc lighting, can be placed underground."

The resolution was seconded by Mr. Lynch, and carried.

MR. GARRATT: I move that the committee now considering the place of meeting be instructed to report on a new executive committee.

The motion was seconded by Mr. DeCamp, and carried.

A paper on the comparative danger of alternate and direct currents by Prof. P. H. Van der Weyde, was read by Arthur Steuart.

THE COMPARATIVE DANGER OF ALTERNATE AND DIRECT CURRENTS.

BY P. H. VAN DER WEYDE, M. D.

It is only a few days ago that I received the flattering invitation to appear before this meeting of the most eminent electricians of the United States, and present a paper containing my conclusions about the comparative danger to life lurking in the alternate and direct dynamo currents. I do so readily, as lately I have had the opportunity to become acquainted with the arguments made at both sides of the question. I was not prepared to do so when, a few months ago, I attended a meeting of the New York Board of Electrical Control, where several papers were read, most of them in opposition to Harold P. Brown, who had expressed himself in opposition to the use of the alternate current system, of which the introduction has lately been commenced. When the president of that meeting asked me to express my opinion I was in the necessity to decline, stating that my appearance there was solely intended to listen to arguments upon the subject about which I desired full information.

As some of the papers read there were written in such a spirit as to compel Mr. Brown to defend himself, I made up my mind to attend his expected defence, especially as it might give me an opportunity to hear what powerful arguments and facts would be brought out by the person who has put himself forward as the champion of the enemies of the alternate current system.

It makes always a painful impression upon me when I see that a scientific investigator feels the necessity to defend himself against personal attacks. The calling of the scientist should simply be confined to ascertain what is the truth; if he thinks to detect erroneous conclusions arrived at by the co-laborer, it is his duty to expose them. At the same time he must mind the old rule, *suaviter in modo, fortiter in re;* therefore, above all, he must let the facts speak for themselves, avoiding any allusion regarding the capability or ulterior motives of his antagonist; in short, he must leave the use of all personalities to the politicians; for these the main considerations are *persons; principles* are secondary and may be changed to suit circumstances, or thrown overboard entirely. In science however, we have to the contrary nothing to do with *persons*, but only with the ultimate *truth*, which we are all striving to arrive at.

At a recent visit to the physical lecture rooms of Columbia College, where I had been invited by telegram to hear the reading of a paper, and a lecture illustrated by experiments by Harold P. Brown, the feeling referred to above was more painful to me than even the howling of the dog which was experimented upon. Dogs have for so many years been considered as the poor legitimate martyrs of science, especially under the hands of physicians and professors of physiology, that we have become more or less hardened in their regard. Nobody will deny the immense value of the increase of our biological and especially pathological knowledge obtained this way.

A great portion of the paper read by Mr. Brown consisted in complaints about the personal attacks made upon his capability, as soon as he asserted in print that the alternate electric currents were more dangerous to human life than the direct currents, namely: that a current of the electromotive force of say 300 volts, alternate current, would be more likely to destroy life than double or triple that strength of direct current.

One feature was prominent in the reading of the paper as well as in the lecture and experiments; it was evident that the purpose was not so much to exhibit what was the truth in the matter, as to show that he was right in what he had asserted.

He attempted to prove this by experimenting upon a large dog, which, when subjected to a direct current, stated to be 300 volts, set up a short howl; 600 volts produced a longer howl and frantic efforts to escape from the cage, while a current of some 900 volts paralyzed the dog, who kept up a labored breathing. Then a representative of the New York Society for the Prevention of Cruelty to Animals interfered, and forbade further trials of this kind, so that Mr. Brown was compelled to give the dog the *coup de grace* by applying the alternate current which he said to be of the strength of only 300 volts.

Unfortunately for Mr. Brown this proved nothing, as the dog was already half dead by the previous successive and increasing direct current doses of 300, 600 and 900 volts respectively. Another dose of 300 or 600 volts direct current might in all probability have ended his life just as well. But what is more, his statement that the alternate current was merely 300 volts was not proved, as he himself had stated previously that reliable instruments for measuring alternate currents were difficult to obtain, and confessed that he had only a voltmeter for this purpose but no ammeter. After the lecture I examined the voltmeter and found that according to the statement of Mr. Brown, himself, its operation was based upon indications of rise in temperature.

Now, it is well known that voltmeters based on this principle are based on false premises; rise of temperature is not produced by electromotive force, but by amount of current; one Wollaston plunge battery cell, of one square meter acting surface, having of course, the electromotive force of only one single volt, will produce far more heat than a series of 24 freshly prepared cups of a Leclanche battery of 40 volts electromotive force. This pretended voltmeter was in fact a kind of ammeter.

This is so self-evident that Prof. G. Forbes from England, who last year exhibited to the Society of Electrical Engineers in New York, a meter for alternate currents, did not think of calling it a voltmeter, because its operation was also based upon the rise of temperature, but he called it a current meter.

This shows that Mr. Brown was mistaken when he said he had no ammeter for alternate current; he had one and supposed it to be a voltmeter; if he used it as such, what becomes of his statement that the alternate current he used was 300 volts?

And here I cannot let the opportunity pass by to repeat what I have been preaching for years namely, that the voltage alone is no criterion in regard to the dangerousness of a current; the danger comes only when the electromotive force—as measured in volts—is accompanied by a sufficient quantity or volume of current—as measured in amperes. An electromotive force carrying a current of only a few micro-amperes, may be as high as 1,000 volts without doing any harm—even when alternating, as proved by the Ruhmkorff coil. It behaves like water oozing out of a pinhole under a pressure of hundreds of pounds; it can do little or no work. At the other side, a very large volume or quantity of current with small electromotive force, of say a small fraction of a volt, will not have the power to pass through the human skin, or even not through the liquids of the body, but only through metals, as proved by the thermo-electric pile. Such currents behave like a large volume of water in a lake, with little or no inducement to make it move; also this will do little or no work.

Prof. Mayer of the Stevens institute, Hoboken, in a lecture recently given to the members of the electric section of the American institute, exhibited some novel experiments intended to measure if possible the voltage of static currents. He used an old fashioned friction electric machine, and showed that the voltage of its currents ran into the thousands, while the amperes were so minute as to escape the possibility of measurement, with the means thus far at disposal.

This leads me back to the subject of the experiment of Mr. Brown; he stated that the quantity of the direct current he used was only a fraction of one ampere. This induced me to examine also the ammeter after the lecture, when I found that the ammeter and the voltmeter were coupled together in series in the same single circuit. Now every experienced electrician knows that in order to measure the capacity of a dynamo current in amperes, we must not place any other resistance in the circuit, much less the high resistance of a voltmeter which may be 500 ohms, as then the indication of the ammeter may drop down 90 per cent. of the original indication; in fact the ammeter indicated actually two-thirds of an ampere as had been stated by Mr. Brown when he was asked during the lecture.

The manner in which the ammeter and voltmeter were used was considered by me in connection with the fact that, if really a current of only two-thirds of an ampere had been obtained, it would render the dynamical value of the three currents used only equal to 200, 400 and 600 watts respectively, which was incompatible with their effect on the dog. This caused me to go to the dynamo plant of Columbia College to inquire. I found that the direct current machine used was an Edison municipal dynamo of 15 amperes and 1,200 volts.

It is likely that Mr. Edison gave it the name of municipal in anticipation of the fact that the municipal governments will need such machines when the new law in regard to capital punishment and of dispatching criminals by electricity instead of hanging goes in operation next year. If so, it is very suggestive, in regard to the controversy we are discussing, that such an able electrician as Mr. Edison is satisfied that a direct current dynamo is all that is needed for that purpose without regard to the alleged greater effectiveness in this respect, of the alternate current dynamos.

This dynamo did not belong to the Columbia college plant, but was furnished by Mr. Edison for the occasion, as well as an alternate current dynamo. Both were removed after Mr. Brown finished his experiments, which it appears he continued privately for a few days after the lecture.

One of the dynamos used belonged to the college plant; it was an incandescent light dynamo, of which the capacity was stated by the engineer to be 125 amperes and 110 volts. This dynamo was employed to obtain the alternate currents, by using it to feed the field magnets of a Siemens-Halske alternate current machine, after the usual manner, as represented in the engraving exhibited here, which shows the essentials of the arrangement used, only with this difference,

that the field magnets of the Siemens alternating machine were supplied by the direct currents obtained from the much larger 125 ampere dynamo referred to, in place of the small one represented in the engraving, at the right hand side below.

The kind of apparatus which was used and the nature of their arrangement, for the production of the alternate current, make it very unlikely that it would produce a current of only 300 volts. Especially when we take in consideration that the current developed must represent some kind of equivalent for the horse power required. First, to drive the 125 ampere incandescent light dynamo, next that required to drive the alternate current dynamo; the latter must have consumed also considerable power, as the 125 ampere current was more than sufficient to saturate its great number of stationary electro-magnets. According to the statement of the engineer, the engine driving the 125 ampere dynamo requires 36 horse power, that of the alternate dynamo, 36 horse power; together 72 horse power, which, at 76 watts per horse power, gives 5,472 watts. If the amperes of such a current had been measured after the method employed by Mr. Brown for the direct current, it would have resulted in 5,472 divided by two-thirds of an ampere, or 8,208 volts.

Of course, this is an exaggerated estimate, but sufficient to show the worthlessness of all the figures as given by Mr. Brown. In order to come to correct conclusions it would be necessary to measure, by means of indicator diagrams, the engine power utilized, and measure the currents obtained by proper instruments, properly used and conscientiously observed.

One thing is certain, namely, that the dynamos used were not of such a defective quality as to warrant the supposition of such an enormous loss of the power applied, as would be the case if only an electromotive force of 300 volts had been obtained.

I must also not omit here to state that if Mr. Brown had known the proper quarters where to apply for apparatus to determine properly the voltage and amperes of alternate currents, he could have been provided, and his labors in this direction might have had some value.

There was added on the lecture room table another important additional—however small—contrivance, for the right understanding and use of which I will have to make a short introductory explanation. I do this also because I have been especially requested to do so by several parties who had become interested in the operation of this, to them, very novel device.

I must ask pardon to bring some elementary considerations before this learned body, but my apology is that this paper will be published and read by many who are not so well informed about electrical subjects, and whose ideas upon it need some clearing up.

Every one who has handled faucets attached to pipes from which water can escape under pressure, will have noticed that when suddenly shutting off the water, a blow like that of a hammer is produced in the pipes. This is caused by the momentum of the water when in motion—often very improperly called inertia—and which shows itself every time this motion is arrested. On this peculiarity is based a contrivance in which, by the automatic alternate opening and closing of a valve, a small portion of the water discharged may be raised to a greater height than that of the original device which produced the pressure. This contrivance has been called a hydraulic ram, and by its help an increase of pressure may be obtained at the expense of a certain quantity of water.

Notwithstanding electricity is not a fluid like water, it behaves, however, in this case, in a similar manner; at the moment a uniform electric current is suddenly interrupted, a current of greater electromotive force (more pressure) is developed in the conductor, and will show itself as a spark at the break of contact, and as a shock through the body when the hands have hold of the wires when the contact is broken. It is a very old observation, and one of the earliest reminiscences of my boyhood—about 1823—that the current of a column of volta of say 30 pairs of plates, scarcely perceptible when closing the circuit through the body, will give a quite sensible shock when breaking the circuit. Such currents have been called extra currents, and they are, of course, stronger in proportion to the strength of the original current, and still further increased by inductive influences when there are coils in the circuit.

As it may be desirable for special purposes to eliminate these currents, an apparatus has been invented, which operates like a very sensitive relay, and then leads these extra currents off, or shunts them in another channel after the manner of lightning protectors. Such an apparatus was on the table during the experiments with the dog, and appeared to be intended to protect the animal against the effect of these extra currents. I must confess not to see why this was done, except for the purpose to annul the most powerful and most dangerous item connected with the direct currents. Therefore, I consider the addition of this contrivance improper if we wish to arrive at the truth in regard to the comparative danger of the alternate and direct currents, because in case of accidental exposure of person there is rarely such a safeguard inclosed in the circuit, and the person struck by the current must submit to the extra current as well.

In order to arrive at the truth of the matter we must also, above all, be able to make definite statements about the voltage and the volume of current, based on precise measurements, which, in regard to the alternate currents, could not be furnished, but was only guessed at.

Finally, as far as I can judge about the matter, guided by the present state of knowledge (especially in regard to some, in many respects, still unexplained peculiarities in the behavior of alternate currents), I should say that the true voltage must be quite high. They do not behave like currents of low voltage—say 300 or 400—as they can be and practically are conducted over much longer lines and thinner wires than is the case with the direct currents of say 1,000 volts. This fact is acknowledged as well by the enemies as by the friends of the alternate current system. Experiments made with converters, especially with a new and very peculiar one of my own construction, appear also to show that there must be considerable voltage in the alternate currents so as to account for the generation of the enormous volume of current into which the electromotive force is converted; in other words, for the thousands of amperes obtained by the conversion of the volts of the primary current, and for which amperes there is no ammeter yet to measure them, but their volume shows itself in the capacity to perform operations requiring the highest temperatures, such as welding iron, fusing the most refractory substances, etc.

Surely no dynamo could be constructed directly generating a current of such volume, as it would destroy itself by the heat of its own current; it is only by alternate current machines of high voltage, assisted by proper converters, that currents of such great volume and high caloric capacity can be obtained.

After all, we must not lose sight of the main object in this controversy, which is the comparative danger lurking in the two systems. When it is found by experience that actually the danger of being killed is greater by the use of alternate currents, it does not make any difference if the voltage which does the killing is 300 or 1,300.

When, however, we consider that statistics show that the loss of life by the direct current system is continually increasing in proportion that the system is extending, the probabilities appear to be that both systems will furnish their equal quota of victims, and the labor of comparing the relative danger of both systems, and especially the discussion about their comparative voltage, appears to become an idle occupation.

Dr. Moses: That very interesting paper calls to our attention some experiments which were made under the ægis of Columbia college, and we all know what it is to have a shadow of a college fall on us. It is a serious thing to raise an objection to anything that comes out of the ivy grown, moss-stained walls of a college However, I would like to warn you, gentlemen, that those experiments were not made by the professor of Columbia college, but by a set of self-constituted investigators who have tried to frighten the public and by holding up a terror before them to scare them into a certain course. I think that one of the most beautiful passages I ever read was in that novel of Bulwer's, where he describes the perfect peace and calmness prevailing at Pompeii before the eruption and the destruction of the city. We have been sitting here as a sort of mutual admiration society, taking in all the compliments, well meant and many of them true, of so wise a man as Mayor Hewitt, and we feel a certain glow of satisfaction which would almost lead us to take our intellectual pocket books out and offer them to the world free of charge. But, gentlemen, something has transpired to day which I think ought to be called to your attention so far as to awaken you from your lethargy, and I will read a passage from a letter in which a keynote of attack is sounded, which I think we ought to reach with serried ranks. This is a letter from Ex-Governor Cornell to Mayor Hewitt. I quote it, as printed in one of the daily papers, and I am told it is the entire letter, with the exception of five unimportant lines :

"The disposition of electrical wires in such manner as to abate their dangerous qualities, and at the same time to preserve their useful features, is a question demanding serious thought and urgent remedy. It has long vainly sought solution, and you are the man who can apply the true and only available corrective. The only remedy now practicable for removing the danger of high tension circuits which presently menace the life and property of our citizens is to absolutely prohibit their use within the city, the strong arm of the state by legislative enactment and honest executive administration of such law positively prohibiting the use of wires bearing the high tension circuits will give us safety. Nothing else can so quickly and surely accomplish it. Will you help us to this result?"

The President: Will you allow me to ask a question there sir?

Dr. Moses: Certainly.

The President: I would like to know if ex-Governor Cornell writes that letter as an expert or as a representative of the Western Union Telegraph company or some other interest.

Dr. Moses: We all know that ex-Governor Cornell is largely interested in the Western Union. We also know his ability and his great influence, and when such a man speaks we must listen and reply. Gentlemen, I have prepared a set of resolutions that I think this National Electric Light association ought to promulgate for their own safety, recollecting the fable in Æsop where the bulls when they kept together could keep off the lion, but the instant they separated they were devoured by him, The effort is made to destroy one of the important interests which it is the duty of this association to foster. I call your attention to it and warn you. Gentlemen, this is the resolution:

"*Whereas*, The National Electric Light association, view with some uneasiness the persistent efforts of rival interests to educate the public to aid distrust of high potential electric currents, and

"*Whereas*, They would protest with all energy against recent efforts to pit against each other the continuous and alternate current systems of electrical distribution, which efforts had as their covert purpose the destruction of the harmony of action now existing between them; and

"*Whereas*, This association, for mutual protection recognize distinctly the danger of unfair legislation such as has destroyed the electric light interests of Great Britain. (Applause).

"*Therefore, be it resolved*, That the National Electric Light association emphatically declare that it is beyond a doubt possible to produce and distribute high tension currents for public use without any more danger or difficulty than attends the distribution of gas and water in our dwellings, and further

"*Be it resolved*, That they would impress all legislators with the fact that success in the electric light and power business is based chiefly upon economy in the size of the distributing conductors and that to utilize this fact high tension currents were adopted in the first stages of development of electric lighting, and have been used ever since and will continue to be used, and further

"*Be it resolved*, That it is our conviction that there is no difference in the dangers attending the use of continuous or alternating currents and that both may be so transformed before being used as to render them a perfectly harmless and practical means of distributing electric power for use in cities."

Mr. Lynch: I second that motion.

Mr. Steuart: This is not a time when it is desirable to harp upon a political issue; but it seems that the policy that is prevalent throughout the country is one that should guide us in adopting these resolutions. The protection of American industries is one of the things which is exciting the public mind. The protection of one of those industries is one of the things for which this organization was formed and one of its greatest elements of usefulness. I can speak from the observation of my friends in England who have told me of the very great depreciation of the electric light business which has been the result of adverse legislation in that country toward electric lighting. The gas interests there are very powerful and they have succeeded in so influencing parliament as to secure the passage of laws which for the past ten years have crippled the industry which has grown to such proportions in this country and I hope that this association will put itself upon record, by adopting these resolutions, as opposing any such policy and as stating to the world our view of the subject as those who have had the most experience and the most practical experience in handling this class of business

T. Carpenter Smith: There is one feature of the legislative interference with the electric light business in Great Britain which I think deserves our very serious consideration. I have no doubt all of us have been reading in English journals descriptions of English installations, and a good many criticisms have been passed on the other side of the water about the flimsy method of installation which prevailed in this country. Now it is very clearly to be traced to the adverse legislation—the fact that there has been very little work done in England and as a consequence of that the few installations that are being operated to-day are being operated in a most reckless manner, such as would not be tolerated in this country. As an instance of that I would mention the fact stated by Mr. MacKenzie, I think at a meeting of telegraph engineers, in reference to the system in the Grosvenor gallery, that he had as many as six buildings cut out by the grounding of wires on the gas pipe fixtures and he recommended that the chandeliers, if they had to be used for electric lighting should be insulated in that way. I don't know how many years it is since we were ordered to put in insulating joints on all lines; but that in 1888 is the condition of the electric light in England, and it is a striking commentary on the effect of adverse legislation. The more the electric light is used the more precaution will be taken with it; for the public are your customers and unless you protect them you will ruin your own interests.

Mr. Lynch read, for the information of such members as were not present at the time Mayor Hewitt delivered his address, that part of his honor's remarks where he referred to the sensational article appearing in the newspapers with respect to the dangerous character of electric light wires.

The resolutions proposed by Dr. Moses were then unanimously adopted.

Prof Liebig read the following paper on electrical measurements.

Some Methods of Electrical Measurement.

BY G. A. LIEBIG, JR.

Among the requirements of modern electrical engineering and the usual practical work in electricity is the ability to make accurate and reliable measurements of current, of potential, of capacity, etc. And with the growth of practical electricity itself goes hand in hand the increasing necessity of instruments of precision and standard apparatus with which the various appliances in everyday use may from time to time be compared.

It may not be out of place, therefore, to give a brief account of some methods of measurement and comparison, many of which have been thoroughly tested, and one or two of which are believed to be new and more reliable than the methods hitherto applied. Let us discuss first of all, the best manner of measuring currents.

Current determinations may very conveniently be divided into two groups, *i. e.*, the measurement of heavy currents and the measurement of small currents. Of the latter very little need be said, as the best method undoubtedly depends upon the use of an electro-dynamometer, and the most suitable form of such an instrument is that of the British association, the well known Weber electro-dynamometer, which has been thoroughly explained and mathematically treated at length by Maxwell. With two or more electro-dynamometers of this kind, currents, ranging from a few milli-amperes to 10 or 25 amperes, can readily be measured with an accuracy of one part in two or three thousand. Currents greater than this must be determined by some other arrangement, since a dynamometer, capable of accurately measuring very heavy currents, would have to be of massive proportions and of correspondingly increased cost. An instrument at the Johns Hopkins university which is intended to measure currents up to fifteen amperes, has fixed coils one meter in diameter.

For heavy currents it has been found advisable to apply the method of "fixed resistances," a method which has been used and successively improved in several electrical exhibitions in this country and abroad, and the range of which is practically unlimited. In this method the current to be measured traverses several heavy German silver bars which have been hard-soldered to a pair of very large copper blocks to which are fastened in the same way the terminals of the galvanometer leads. The bars and end blocks are immersed in a tank of refined petroleum and their temperature, by stirring constantly the oil, can be determined to a few hundredths of a degree. To use this apparatus a known current, meas-

ured by an electro-dynamometer, is sent through the fixed resistance, and the potential at the ends determined by the galvanometer joined at these points. The deflection of the latter corresponding to any other current gives us at once a measure of the current. In practice a resistance box is placed in circuit with the potential galvanometer and the resistances always adjusted until approximately the same deflection is obtained. By doing this we render ourselves independent of the assumption that the angular deviation of the galvanometer needle is proportional to the current, except for exceedingly small differences. It is to be noticed however that the calibrating current is measured by an electro-dynamometer and not by a galvanometer, the reason being that the former is independent of the value of H (the earth's horizontal component), whereas any error in the determination of H appears directly in the galvanometer constant.

During the measurements the oil in the tank is constantly stirred and its temperature noted. As a matter of fact, this is found to change but little even with currents of 200 amperes or more.

Calling R_0 the resistance of the German silver wire at 0° C., β its temperature coefficient, T_1 and T_2 temperature of the same corresponding to current C_1 and C_2, D_1 and D_2 ι_1 and ι_2, t_1 and t_2 the deflections of galvanometer, adjusted resistances and their temperatures, corresponding to current C_1 and C_2 we have:

$$C_2 = C_1 \frac{D_2 (1 + a t_2)}{D_1 (1 + a t_1)} \frac{\iota_2}{\iota_1} \cdot \frac{R_0 (1 + \beta T_1)}{R_0 (1 + \beta T_2)}$$

a being the temperature coefficient of the resistance box. The terms relating to changes of the resistance R_0, *i. e.* of the German silver bars can generally be neglected.

Potential measurements can be made in exactly the same general manner, the fixed resistance used for this purpose being however, very much higher. A known current is passed through the German silver reel, forming the fixed resistance, and the deflection of the galvanometer, joined to its ends, is noted. A resistance box in circuit with the galvanometer enables us to reduce this deflection to a convenient angle. Care must be taken that the current used for calibrating the galvanometer be so small as to heat the fixed resistance as little as possible. After the calibration is completed, the galvanometer is joined to points whose electromotive force we wish to measure and the resistance box adjusted until the same deflection as before is secured. We have, then, an expression for the potential, of exactly the same form as the one given before. For very high potentials the method is inapplicable, and recourse must be had to an absolute electrometer of the kind first described by Sir Wm. Thomson. In this instrument, fully explained in Thomson's papers, the difference of potential between two points is measured by the attraction between two disks electrified to the same difference of potential, one of them being balanced by a series of weights, the other being fixed. With such an instrument electromotive forces varying from 1,000 volts to over 100,000 volts can easily be measured, and it thus offers an excellent means of comparison with electrostatic voltmeters. etc.

There is perhaps no better way of measuring resistances than by the employment of some accurate and sensitive form of Wheatstone bridge. The only difficulty encountered in such measurements is the exact determination of the temperature of the various resistance coils, and standards in use during the work. It has been found absolutely necessary to immerse all the measuring coils in liquid during the use of the apparatus, and to allow them to remain in a room whose temperature is almost constant several hours before any measurements are made. Even thin glass tubes containing mercury and surrounded on all sides with cracked ice have been found to require at least five or six hours for their temperature to fall to zero.

The efficiency of dynamos and motors can be determined with all necessary accuracy by means of any one of several dynamometers, of distinct types, and now well-known, and the subject is one which presents no difficulty whatever until the attempt is made to measure the efficiency of very small machines; that is, machines of one horse power and less. In those cases it has become necessary to devise a way of measuring which shall greatly reduce errors ordinarily encountered. The difficulty generally presented is that the dynamometer itself absorbs in friction so much energy that the loss thus occasioned amounts to a large proportion of the total activity of the machine under examination. The cradle dynamometer is perhaps free from this objection, but it must be rejected on account of the uncertain but large errors introduced by slight errors of centering. Hopkinson's method might be employed were it not that it requires two machines to experiment upon; an obstacle which in most cases would be a serious one. A method which appears to be devoid of the objections just enumerated is a modified calorimetric method. To employ this the motor or dynamo, as the case may be, is surrounded by an air-tight water jacket through which circulates a stream of water at a uniform temperature. The dynamo is allowed to run under a given load until all the effects of heating have become constant; this includes the heating resulting from mechanical friction, and from the current itself. After this the flow of water is determined, its temperature carefully noted, and from these data the losses occurring in the motor are at once deducible. There appears to be nothing in the way of making the method universally applicable to small machines and the indications are that its adoption would lead to very accurate results. This method was first proposed by Dr. Duncan as a means of measuring the efficiency of alternating current converters.

Several methods of determining the magnetic qualities of iron and steel have been published. They all depend upon the measurement by a ballistic galvanometer of the induction through a coil wound about the specimen to be tested, either when the coil is moved, the current reversed, or reduced to zero. These methods offer no difficulty, and a ballistic galvanometer can easily be calibrated in absolute measure by the use of an earth inductor or even a coil of wire of a few turns, its constants having been determined by measurement and simple calculation.

DR. MOSES: Would Prof Liebig be so kind as to explain to us how in the measurement of small machines the difficulties developed themselves.

PROF. LIEBIG: The difficulty we had was that the dynamometer used required so much power to move it. The dynamometer that is best fitted for that work is perhaps the Taten dynamometer, but it cannot be very well made on a very small scale, and it absorbs something like half to three quarters of a horse power to run it, so if you want to measure the efficiency of a one horse motor you have very little to go on.

DR. MOSES: Has Prof Liebig determined the relative losses of direct and alternating motors?

DR. LIEBIG: I have not as yet taken up that subject.

THE PRESIDENT: Gentlemen, if there is no further discussion upon this paper we will pass on to the paper by Mr. Steuart on patent legislation.

REPORT OF COMMITTEE ON PATENT LEGISLATION.

MR. STEUART spoke at length of the work of the committee in preparing the bill establishing a court of patent appeals (WESTERN ELECTRICIAN, p. 312, No. 25, vol. II) and read the letters commending the bill (p. 310 same issue) and then said:

This bill was introduced into congress the 2d of April, and was immediately referred to the judiciary committee of the house. It was referred to the patent committee of the senate. The judiciary committee of the house has been the field of our labor since that time and I fear that the members of that committee have begun to think that I have gone mad on this subject; but any of you who have had experience with the procurement of legislation from congress have found that the most persistent, constant, untiring effort is necessary in order to get an action from any of the committees Mr. Hall, the commissioner of patents, Mr. Dodge, the president of the Patent Bar association the Hon. George Ticknor Curtis, whom I interested in the measure, other gentlemen from elsewhere and myself, have been before that committee over and over again. We have been there twenty times if we have been there once. We have argued with them hour by hour and I have here in my hands a batch of articles upon this subject which have been prepared by very eminent men in various parts of the country—by Mr. Walker of Hartford, Mr. Mason of Detroit, Mr. Dodge of Washington, Mr. Curtis of New York, all of them tending to demonstrate the necessity for the creation of such a court, and of the purpose of providing to the members of congress the desirability of passing this measure. The day before I came away from home I had the gratification in receiving a telegram from the chairman of the judiciary committee of the house saying that after careful consideration that committee had authorized him to report this bill to the house with a recommendation for its immediate passage (Applause) I cannot say what the house will do with it, but I have heard few dissenting voices, and I am disposed to hope that if the members of this association will aid me by individually approaching their members of congress and indicating to them that it is very desirable that this bill shall pass, that it will become a law, and I hope that when you go home every one of you will take the very first opportunity of either writing or going to Washington, seeing your members of congress, and impressing upon them your personal desire that this thing shall go through.

I may say that the house committee have cut down the court from five to three members and have cut down the salary from $8,000 to $6,000. I am sorry for that. The burden cast upon this court by the transfer to it of cases now on the docket of the Supreme court will be very heavy and the mass of business thrown upon them will be very great. I do not think that three men can do the work. The senate committee that has the matter in charge have assured me that when the bill comes to them they will alter that, and instead of lowering will increase the court to seven members and the salary to $9,000, so that we may hope to get good men. It is a question of policy as to whether it would be better for us to let the bill go through in the form in which it has been reported to the house, get the court, try the experiment, and if the justices are overburdened with their work, increase their number afterward or whether it would be better not to take our court at all until we can get what we want. My disposition is to let the bill pass through the senate in the form in which it comes from the house; let the court be appointed and let them try the work and see how they get along with it.

There is only one other word I will say in this connection. The work of this committee heretofore has cost within a few dollars of $700. When I undertook this work I estimated the cost at $1,500. I said I thought it could be done within that figure. The members of the association have been very liberal and prompt in supplying the necessary money. Seven hundred odd dollars were subscribed, and seven hundred dollars of it have been spent. It remains with the members of the association to say whether this work shall go on or whether it shall stop. It is impossible to prosecute it without sufficient money for the conduct of correspondence, which has made it necessary to employ a clerk, and I may say that for the past six months the work of this committee has occupied the whole time of one clerk in my office, every bit of it, and he is a stenographer, and as much time as I could give to it in addition, the clerk simply of course doing the manual work. It remains for the members of this association to continue this work or to stop it now. We want a little more money in it—a few hundred dollars—and we believe that the benefit of this measure to the members of the association will be so great that whatever they may spend upon it they will be well compensated for (applause).

MR. FOOTE: As I was one of the few at the last meeting of this association to give our friend Mr. Steuart a little encouragement in his work, I deem it a privilege now to express to him my personal thanks and I hope the thanks of all the members present for the work he has done. I think he has got it in excellent shape and that it should be carried forward. With regard to the question he asks about having the bill passed as it is, either an increase of judges or salary, I think the principle recognized in all legislation is first get your commission, then give them power. On that principle I would favor any action that would secure the court. Having secured that, if we find it inadequate to its work it will be easy enough to increase their number, their compensation and all necessaries to carry on the business.

MR. STEUART: I failed to say one thing which I think it right to say and that is that the money which has been expended on the work of this committee had been the voluntary contribution of individual members of the association who have been sufficiently interested to come forward and supply the funds. I do not ask that any of the funds of the association be applied to this purpose. I am satisfied that if the work is continued and if the association feels interested in it and approves of the work as it has been done, that funds will be forthcoming from the individual members to carry it on.

MR. WEEKS: I move that the report of the committee be received and filed and the committee continued; and in making that motion I want to say that I feel proud of our legal committee I think they have accomplished a noble work and I feel quite sure from what I have heard from members of congress that they are on the way to success.

MR. GARRATT: I second that motion.

THE PRESIDENT: You have heard the motion, gentlemen, which is that the report of the legal committee be received and filed, and that the committee be continued to prosecute the work as laid out.

THE PRESIDENT: Before putting the motion for the adoption of the report and continuing the committee, I would like to say one or two words. I took the pains to go down to Washington at Mr. Steuart's request to aid him as much as possible in the prosecution of this work before the committee; and no man, unless he has been through that kind of legislation, can appreciate the amount of hard work and labor it is to see the various members of the committee of a legislature or of congress, the amount of time spent in hunting them up, the amount of time spent in trying to get a quorum; add to that the amount of labor that Mr. Steuart has performed in conducting all this correspondence, and in collecting data and the opinions of these learned gentlemen, and the indorsement which he has secured from the legal fraternity and the members of the Supreme court itself—consider all that and it is certainly something that deserves the thanks of the association. You know we restricted the committee in this way: We said we will give you the moral backing of the association to prosecute this work, but we will give you no money. Now that is a pretty easy thing to do But as he says, the individual members of the association have stepped forth and so far paid the expenses. It is gratifying to know that outside of ourselves, as an organization, the membership feels such an interest in matters of this kind that they are willing voluntarily to come forward with sufficient funds to prosecute a work of that nature.

The motion was carried.

MR FOOTE: I now offer as a resolution that the treasurer of this association be authorized to open a subscription for a fund to defray the expenses of the work of this committee

The motion was seconded and carried

THE PRESIDENT: The next paper is that upon Electrical Education, by E. R. Weeks, of Kansas City.

ELECTRICAL EDUCATION.

BY EDWIN RUTHVEN WEEKS.

The signs of the times point to a growing interest in electrical education. In the rapid development of the applications of electricity, the demand for skilled workmen far exceeds the supply, and both employers and employes are beginning to realize that the men at hand must be assisted to a mental culture, whose lack is one of the drawbacks to perfect service.

In response to a few remarks made on this subject at the Boston convention I received so many letters of inquiry as to the ways and means of acquiring knowledge which will be of practical value to the workman, that it may be profitable to outline a plan that has proved its working value to employes of all grades of educational advancement, the greater number of whom, however, had previously had so little commerce with books as to be almost helpless before a small library.

When the full measure of the utility of electricity has been reached and when schools have had time to understand the needs of electrical engineering, the work of the college will afford all the preparation that theory can give. Already good courses in this line of investigation have been added to the curricula of many universities. With this branch of the subject we are not at present concerned. But it may be said in passing that the practical work in the factories, which is intended to supplement the college course, is not sufficient to make a man an electrical engineer. So great has been the demand for "expert" service, that many new fledged bachelors of science have been rushed through factories and sent out to do work requiring manual dexterity and an intimate practical knowledge of the operation of apparatus under widely varying conditions. Before the student enters the factory he should have taken his degree and should have spent at least a year at central station work where he may learn the use of his hands and may become familiar with many variations of trouble and gain an experience which will render the factory course of greater value to him. However, our immediate concern is how to help the army of raw recruits that the youth and rapid growth of our industry necessitates, to acquire most quickly an intelligent, practical, working knowledge of the service.

The mutual improvement society organized among the employes of the Kansas City Electric Light company has learned numerous lessons in regard to proper methods, useful books and the use of them, and in order to open the discussion on this phase of electrical education, I have consented to outline the work of that society. In 1885 the company provided a commodious reading room

and a large audience room fitted with a library, paper files, black boards, tables, writing materials, etc. Some half dozen electrical papers and magazines are here on file and the library now contains over one hundred volumes

Twenty-five of these volumes, chosen with an eye to simplicity, served as a nucleus to which additions have from time to time been made. The selection of books for first use was an important work, as many texts are gotten up in a style and nomenclature entirely beyond the taste and reading ability of the ordinary dynamo, lamp, and line man. The officers of the company made it a point to talk with the men on various subjects treated in the periodicals and books, and to call attention to articles that might be helpful. Other things being equal, those who showed, in their conversation, that they had been studying, are first promoted. The librarian has kept a record of the books taken out, which shows that next to the unabridged dictionary, the one in greatest demand has been "Electricity in the Service of Man," by Dr. Alfred Ritter Von Urbanitzky. Almost every member of the society has read it and some, several times. Next in popularity stand "Elementary Lessons in Electricity and Magnetism," by Thompson, the works of Gordon, Holmes and DuMoncel on "Practical Electric Lighting" and "Electricity, Its Theory, Sources and Applications," by Sprague Several copies of each of these works had finally to be provided to meet the frequent calls. Men in all branches of the service read them and find that their perusal results in great benefit A recent addition to the library, F. M. Kimball's "The Dynamo—How it is Made and How to Use It," whose simplicity and brevity will commend it to every workman, bids fair to become the most popular book with beginners "Short Lectures to Electrical Artisans," by Fleming, "Elementary Treatise on Electric Batteries," by Niaudet, Hospitalier's "Domestic Electricity," Brennan's 'Electricity and Its Discovery,' and Jeans' "Lives of Electricians," "The Electric Motor and Its Applications," by Martin and Wetzler, "Electrical Measurement and Galvanometer," by Lockwood, Day's "Electric Light Arithmetic," "Dynamo Electric Machines," by Thompson, and Pray's "Twenty Years with the Indicator" are also favorite works

The more purely theoretical treatises are taken out by few, but the number of their readers is gradually increasing. Among the more recent publications, there is one book deserving special mention. It is Mr. Hering's "Principles of Dynamo Electric Machines" which for its clearness, accuracy and subject matter should be in the hands of electrical readers of all classes.

The success of the reading room soon led to the organization of the Gramme society, and the work of its members shows that the men are learning how to read There was, at first, a little opposition to it among the men, some of whom objected to giving away the information which they had gained by hard knocks against experience. But this feeling has gradually died out, and all have come to realize that, in the words of one of our linemen, "This is a case where one can give away his cake and eat it too" An additional inducement to membership was offered by establishing a relief fund in the society, to which each member subscribes at least twenty-five cents a month, the aggregate monthly subscription being doubled by the company. In case of sickness or disability of any member, he receives his pro rata share of the fund and more should the society so decree. So that now, although the membership is not compulsory, most of the men in the service of the company have joined.

The meetings were formerly held on Sunday afternoon, but Tuesday evening was finally selected as a better time. The organization is of the simplest, and there is no membership fee. The officers are elected annually and a committee appointed by the chair chooses the subjects and leaders of discussion under advice of the general manager, who endeavors to so direct the whole work, that a reading of current electrical literature shall be necessary to the intelligent hearing of various talks. Care is taken to assign each topic to those who have had the most practical experience in regard to it. Among the subjects already considered are "A Talk on magnets," "Early history and sources of electricity," "The new light," "Technical terms," "Electrical units," "Ohm's law," "Shunts," "The arc lamp," "The incandescent lamp," "Carbons," "Construction and maintenance of lines," "Danger from shocks," "Grounds, crosses and short circuits," "Lubrication and the proper care of journals," "Various types of dynamo electric machines," "The Edison and Thomson-Houston machines, their construction and proper care," and "The alternating current system." The discussions of some of these subjects required several meetings. In addition to the working topics, a biographical sketch of some noted scientist, especially an electrician, is given, and is found to awaken a deeper interest in electrical study. The discussion of the subjects is both theoretical and practical, and the speakers have been led to a free use of the blackboard for synopses, diagrams, and illustrations.

The beginnings of the work were rather disheartening, and it required a great deal of enthusiasm and patience on the part of its inaugurators, to induce the men to take any useful part in the exercises It was only by continual questionings and references to books and periodicals, by pointing out the advantage to be derived from the perusal of this or that article in this or that paper or book, the constant recognition of the good work of each speaker and the ignoring of the weak and useless, that the men were gradually encouraged to take hold of the subjects in a free and easy way, and to give up the cream of their experience without fear of losing it.

But the results have amply repaid all efforts and the growing interest of the members, their anxiety for perfect equipment and above all, their ready expression of the advantage which the necessary reading and interchange of thought have been to them, are most gratifying proofs of the wisdom of the movement.

Those members of the society whose information lay chiefly in a practical direction, have added to that information and have gained a knowledge of some of the principles underlying our industry. They are thus deriving more pleasure from their work, and are on the way to a higher and wider field of usefulness. Those whose information was mostly of a theoretical nature have climbed such information and have acquired a more intimate knowledge of the apparatus used, and are thus better prepared to discharge the duties devolving upon them.

The benefits of this work to the company are evident in the improved condition of all parts of the service, and in the interest which the employes take in perfecting it—an interest which has grown out of the dawning perception that the company has at heart the good of its workmen, as well as the increase of its dividends

List of Books in the Library of the Gramme Society.

Alglave & Boulard—The Electric Light, History, Production, etc.
American Electrical Directory.
Anderson—Lightning Conductors.
Atkinson—Static Electricity.
Ayrton—Practical Electricity.
Benjamin—Age of Electricity.
Blakesley—Alternating Currents.
Bottone—The Dynamo, How Made and How Used.
Braunt & Wahl—Techno Chemical Receipt Book.
Brennan—Electricity and Its Discoverers.
Browne—Fuel and Water.
Buel—Safety Valves.
Colburn—Steam Boiler Explosions.
Cooke—The New Chemistry.
Cotterill—Applied Mechanics
Cumming—Introduction to the Theory of Electricity.
Day—Electrical and Magnetic Measurements.
Day—Electric Light Arithmetic.
Deschanel—Natural Philosophy.
DuMoncel—Electric Lighting.
DuMoncel—Electricity as a Motive Power.
DuMoncel—Incandescent Electric Lights.
DuMoncel—Electric Magnets.
Dyer—Induction Coils.
Everett—Elementary Treatise on Natural Philosophy.
Faraday—Experimental Researches in Electricity.
Fiske—Electricity and Electrical Engineering.
Fleming—Short Lectures to Electrical Artisans.
Gordon—Physical Treatise on Electricity and Magnetism.
Gordon—Practical Treatise on Electric Lighting.
Gordon—School Electricity.
Haskins—The Galvanometer.
Hering—Principles of Dynamo Electric Machines.
Holmes—Practical Electric Lighting.
Hopkinson—Dynamic Electricity.
Hospitalier—Domestic Electricity.
Hospitalier—Modern Applications of Electricity.
Jeans—Lives of Electricians.
Jenkin—Electricity and Magnetism.
Kapp—Electric Transmission of Energy.
Kempe—Hand Book of Electrical Testing.
Kimball—The Dynamo, How It is Made and How to Use It.
Lockwood—Electrical Measurement and the Galvanometer
Lockwood—Electricity, Magnetism and the Electric Telegraph.
Lowell—Nature of Light.
Maier—Arc and Glow Lamps.
Martin and Wetzler—The Electric Motor.
Maxwell—Electricity and Magnetism.
Monroe and Jamieson—Pocket Book of Electrical Rules and Tables.
Niaudet—Elementary Treatise on Electric Batteries.
Noad—Students' Text Book of Electricity.
Plante—Storage of Electrical Energy
Pray—Twenty Years with the Indicator.
Prescott—Bell's Electric Speaking Telephone.
Prescott—Electricity and the Electric Telegraph.
Proceedings The Association of Edison Illuminating companies.
Proceedings The National Electric Light Association.
Pynchon—Chemical Physics.
Radau—Wonders of Acoustics.

THE PRESIDENT: You now have before you for discussion this very able and practical paper of Mr Weeks, showing a school for imparting practical knowledge right under the management of the company, guiding those men in such channels as to give them the most practical and useful knowledge.

DR. MOSES: I have enjoyed that paper very much indeed. I think Mr. Weeks has set a very good example to all companies. In the pressure of business stress enough is not laid on the education of the men to carry it out. There is no relaxation to the hard-working man equivalent to studying up why he works, and how to ease his work It is very necessary that the people who are employed in the lower positions should be better educated They are apt to get into a perfunctory way of doing their duty. Many an important thing, too, is suggested by the man who is engaged in running the apparatus after it has been invented and developed A very notable instance of this has been called to my mind. Some of the most beautiful and complicated machinery in existence is that used in the separation of sugar from molasses. It was a problem how to accomplish that for a long time, until a great firm in England took it up and solved it, and put a great deal of money into it. They started the machinery after their preliminary tests, which lasted a few days at a time, and they discovered at the end of a week that their perforated cylinder, through which by centrifugal force the molasses was projected and the sugar separated from it, became clogged. One of the workmen, after they had tried every means in the world to get over the difficulty, suggested very naturally, "Throw a jet of steam on it and soften this glue;" this glue of gluten and glucose that stopped up the opening of this perforated cylinder. That operation removed the difficulty, and the result was, as I have heard, that the workman who suggested it got a very large interest in the business, and a patent was taken out for it. It is a great incentive to a man who has an idea to know that it can be utilized. Every man works for a certain meed of praise. Some men say interest is the prime motor. I say not. Self-gratulation is the prime motor. Encourage your workmen as much as you possibly can and they will give you good results.

In an humble way I have been at work on something in the same province. I take pleasure in announcing to you that I am now trying to breed up for you a class of workmen who will take charge of many of the positions in the stations, and who in your establishment will be able to do a great deal of work for you, and do it intelligently Next year I hope to be able to tell you some practical results from it. There is a school in this city with which I happen to be connected as director and vice president, which has for four years been engaged in educating poor boys. We have now about 125 boys under tuition I have tried to develop in that school a system by which those boys may become useful. I look upon the electrical business as the rising business of this country All other forms of business in which motive power is developed will gradually be absorbed by it, and the workmen necessary to be employed in that are very scarce, and are becoming scarcer every day We have been dependent on foreign importations altogether for our supply of skilled workmen. They have somewhat banded themselves together, and it is very difficult for a native to get that education which we find many of our foreign workmen have. The object of this school is, as I say, to furnish young skilled apprentices, thoroughly educated in electrical methods and for electrical purposes. I hope next year—though we have some twenty-five or thirty of our boys at different electrical works doing very good work to be able to announce to you that the matter has taken such shape that you may look to them for a certain supply of material. Now this plan of Mr. Weeks is developing the education of the workmen in another direction. I am very glad to see that Mr. Weeks, who seems to be a born educator himself, has directed his attention to it

MR. FOOTE: Mr. President, I consider this subject of education as the basis of our business. While here I have taken the pains to buy every periodical I could find treating on the subject, calculating to give it to our workmen. I have asked for an estimate of the cost of all the books published in this catalogue, and I find that $405.25 will buy the entire list—probably with a discount of about 10 per cent. A point that Mr. Weeks touched upon I have had a little experience in, and that is that some of the workmen do not like to give away what they know—what they have learned practically. I wish to say for the information of the convention that about six weeks ago I had occasion to learn something. I addressed a letter of inquiry to the managers of 100 central stations, located in every state in the United States. I have received to that letter of inquiry up to to day eighty-six answers, and all of the answers have given me in the fullest detail which the writer possessed the ability to give a full answer to the questions I asked. That experience gives me a good deal of faith to believe that the question which the committee on insulation have formulated and sent out will produce a great deal of good in bringing in answers. It struck me while Mr. Weeks was reading his paper that possibly it might be well to institute some sort of a circulating library scheme among the local companies, etc., in the different localities where, if one cannot get hold of the book, by having a small fee for the use of the book, a fund could be raised by which any book published in the world can be made available to any man who has the intelligence to read it.

MR. STEUART: I have been deeply interested in this paper of Mr. Weeks, and also in the remarks of Dr. Moses upon this subject, and I would throw out for your consideration one suggestion: The greatest educational influence that has ever been brought to bear upon a community, the greatest influence for practical progress in the development of the arts, has been the patent system of the United States. It has done more to make this business than any other one cause, and I would suggest to you that the spirit of that system is that the government of this country exercises a paternal care over its citizens, and extends to them the strength of its arm in protecting them in whatever new step forward they may make in the development of any branch of science or art. The result is that every citizen of this country feels that what he may do, what he may create as a step forward in the arts, becomes his property in the present state of our law, and that he may reap from it the benefit which he certainly deserves. There are some manufacturing organizations in this country that have tried the experiment, and have found it most successful, of constituting themselves a patriarchal government over their employes in the same spirit and under a somewhat similar system as that which exists under our patent law, and I would ask you to consider that suggestion that you put before your men a proposition that they shall exert their very best endeavors to improve the condition of your service, and that for every idea of improvement that they present they shall receive recognition. That recognition, I feel satisfied, will give you a quality of service that will pay you for its cost.

MR. LYNCH: I must say that I have been highly interested in these remarks of Mr. Weeks, Dr. Moses and Mr. Steuart; and for the purpose of following up this very interesting topic I will offer the following resolution, and suggest the appointment of a committee of three, Mr. Weeks to act as chairman, for the purpose of communicating with and suggesting to all our scientific colleges that they should follow up a course of practical electric instruction.

THE PRESIDENT: Please pass it up. The resolution is that a committee of three, of which Mr. Weeks shall be chairman, be appointed to suggest and recommend to all our scientific colleges a course of practical electric lighting education. Gentlemen, you have heard the resolution.

Mr. Weeks asked that Dr. Moses be appointed chairman of the committee.

Dr. Moses: Let me say that the experiment is being tried. Before we recommend that this shall be done, perhaps it should be tried in such a way as it is now being experimented with. I would say, in justice to those gentlemen who have furnished the capital for this experiment that they have already invested about $75,000 in it and they are perfectly well satisfied to put more out and are only now just experimenting in that direction. They have under my advice concluded that this would be as good a field as any for the graduates of the schools. It is a charitable institution, but at the same time that resolution is a very excellent one and will very considerably support me in my effort if it goes out authoritatively from this body that they recommend all colleges to do it. Since the greater contains the less, I would be supported by the association in that resolution.

The President: This is a rather broad resolution it seems to me I think if that were so worded as to direct the committee to consider the advisability of making a recommendation of that kind, it would be more appropriate.

Mr. Lynch: I will amend it to that effect.

The resolution was adopted.

The President: Before going any further, gentlemen, I desire to refer to some statistics presented by Dr Wheeler to our stenographer in order that they may go on the records, and complete his report. Some of it is the information asked for yesterday in regard to the number of dead wires and dead poles and so on in the city of New York. If the gentlemen desire to hear it the chair will read it, although you will have to do considerable figuring to ascertain what you want anyhow. So perhaps I had better refer it as a matter of record to the stenographer, so that it will come in in the proper place.

The paper spoken of by the president is as follows:

Report of Electrical Expert from June 15 to Aug. 24, 1888.

NAME OF COMPANY.	No. of Violations.	Notices Sent.	Second Notice.	Notice Answered.	Notice Attended to.	Notice Sent to B. of I.	Notices.	Referred to Board.
U. S. Company.								
Dead Poles	113	38	10	2		4		
Dead Wires	283	173	52	29	20	46		
Useless Fixtures and Wires	28	26	11	6		1	2	
Lamps Low	28	26	11	2	2		1	
Wires not Insulated	60	53	2	17	25			
Dangerous Poles	1	1						
Total	513	317	86	56	47	51	3	
Brush Company.								
Dead Poles	42	14	2	1	4	4		
Dead Wires	34	27	3	16	11	3		
Wires not Insulated	30	29	10	6	12			
Dangerous Circuits	3	3		3	3			
Slack Wires	1	1						
Total	110	74	15	26	29	7		
Met. T. & T. Company.								
Dead Wires	60	41	5	19	27			
Dangerous Poles	1	1						
Total	61	42	5	19	27			
Fire Department.								
Dead Wires	43	23	2					
Dead Poles	2	2						
Dangerous Poles	2	2						
Other Violations	2	2						
Total	49	29	2					
W. U. T Company.								
Dead Wires	69	41	3	2	13	2		
Dead Poles	6	5			1			
Slack Wires	1	1						
Total	76	47	3	2	14	2		
Mount M. E. Company.								
Lamps Low	8	8		8		1	8	
Total	8	8		8		1	8	
East R. E. L. Company.								
Dead Wires	13	11						
Lamps Low	2	2						
Total	15	13						
Daft M. P. Company.								
Dangerous Circuit	1	1						
Other Violations	1	1						
Total	2	2						
Postal T. Company.								
Dead Wires	3							
Dangerous Poles		1			1			
Total	4	1			1			
American Dist. T. Company.								
Dead Wires	14	8	1		2			
Dangerous Circuits	2	2						
Total	16	10	1		2			
Police Department.								
Dead Wires	15	4						
Dead Poles	8	2						
Total	13	6						
Grand Total	867	548	112	111	121	61		

Notices sent to Bureau of Incumbrances of Dead Wires and Dead Poles 192
548

Total Notices 740

The President: Gentlemen, before taking up the last subject of discussion, the paper of Mr. Lufkin on motors, we will take up the reports of the various committees not on the desk. The first is the committee on the place of meeting, and the nomination of the executive committee.

The report, signed by C A. Brown, A. J. DeCamp, H. D. Stanley, Thos. Officer, E. R. Weeks, is as follows:

"Your committee appointed to select a place for the next annual meeting of the Electric Light association begs leave to report: That it recommends the city of Chicago for such place of meeting. So far as your committee has been able to learn, there is a general sentiment in favor of holding this meeting in some western city, and other western cities have consented to waive their claims for the next meeting in favor of Chicago. As members of the executive committee for the ensuing year, we recommend the following names: Chairman, B. E. Sunny, Chicago; S. A. Barton, Chicago; W. A. Kreidler, Chicago; O. A Moses, New York; E. F. Peck, Brooklyn; J. F. Morrison, Baltimore; E. T. Lynch, jr, New York; T C. Smith, Philadelphia; F Ridlon, Boston."

The report was adopted.

The secretary was instructed to cast ballots for the members of the executive committee.

The President: The next committee to report is the committee on the recommendations of the president Is that committee ready to report?

Mr. Steuart presented the following report, signed by Arthur Steuart, Edwin F. Weeks, A. F. Mason, Henry D. Stanley:

"Mr. President and Gentlemen: I am instructed by the committee on the president's recommendations of which I have the honor to be chairman, to make the following report: There is but one subject contained in these recommendations that has not already been disposed of by the convention, and that is the question of establishing a permanent office for the association. Ever since the organization of the association a need has been felt for some permanent officer who would be in a position to gather up all the threads of the association's work and bring them to a practical point; collect and collate information needed by the members and not furnished by the reports of the convention; and have this information ready for the use of the members when needed. It has not heretofore been thought best to undertake this work, but your committee after careful consideration agree with the president in thinking that the time has come for the establishment of such an office.

"They also think that the officer proposed should be a person thoroughly familiar with the field of electric lighting and kindred subjects, and that his office should be located in the city of New York, and be furnished with such a collection of books and magazines as would enable him to keep himself abreast of the development of the science and the industry. The committee therefore recommend that a resolution be adopted by the convention to the effect that the association have a permanent location in the city of New York, and that the position of secretary and treasurer of the association be held by an expert electrical engineer, and they recommend that the president at once take steps to nominate a suitable person for this position. and select a suitable location in this city for a general office."

The committee submitted the following resolution:

"*Resolved*, That this association shall hereafter have a permanent office in the city of New York, which shall be in charge of an expert electrical engineer, who shall be secretary and treasurer of the asssociation, and that the president at once take steps to procure the services of such a person and establish him in suitable quarters and with suitable facilities in this city."

Mr. Phelps: I move the adoption of the report.

The motion was seconded.

The President: It is moved that the report of the committee be received and filed, and the resolution read be adopted.

Dr. Moses: It seems to me, in connection with that report, that we ought to take into consideration the valuable service of the secretary, and before that resolution is offered I would propose a substitute for it, or at least an antecedent resolution in which Mr Harding's services shall be properly recognized by the association. As we have been faithfully served by Mr. Harding, I think that he should receive some recognition from us for that, in the way of a vote of thanks and appreciation in this convention. I therefore move that the appreciative thanks of this association be tendered through the president to Mr. Harding of Baltimore, for the zealous manner in which he has performed the functions of his office, the care that he has taken to have everything in the way of records properly prepared, and that we congratulate ourselves upon having had as secretary, our first salaried officer, so efficient a one as Mr. Harding.

Mr. Steuart: I am prepared to second that motion in the name of the committee.

Mr. DeCamp: I am in entire sympathy with the report, but does it follow that the present secretary retires from his position at the close of this convention?

The President: Not necessarily so, but the resolution certainly implies the employment of an expert electrician in that capacity.

Mr. DeCamp: What I wanted to say was that I am not a believer in going into a new move without first knowing how you are coming out. Of course the salary of your new secretary is in the hands of the executive committee; but there are many other expenses attending an office of that kind, to establish it permanently in one place, which ought to be determined before such steps are taken. We may be swamped. I have no resolution to offer on the subject. I think that that move is one so proper and necessary that perhaps we can afford to take more than the usual risk in it.

The President: Will the chairman of the committee state if the committee has ascertained about what the expense will be, and if the association, in their judgment, is able to meet it?

Mr. Steuart: The committee would only say that during the coming year the income of the association will be somewhere between four and five thousand dollars. In view of that fact, the committee thought that half of that sum might be expended for the purposes of maintaining this office.

The resolution of thanks to Mr. Harding was unanimously adopted by a rising vote.

The motion to receive the report of the committee and adopt the resolution proposed by the committee was carried.

The President: I have here a telegram—a somewhat peculiar telegram:

"Cincinnati, O., Aug. 31. *President National Electric Light Association:* Have association select an expert to act with our committee on award for electrical appliances. Will inform you later when he will be needed.

"L. C. Goodall, Chairman."

Gentlemen, what is your pleasure? It is the business of the association, not mine.

Mr. Foote: In explanation of that telegram, I wish to say to the association that the commissioners of the Centennial exhibition in Cincinnati have expended about $40,000 in electric lighting and electrical display in the exposition. In addition to what they have put in there are several private displays. They have, as the telegram would indicate, some committees to examine this electrical work. As we have no local talent in the city of Cincinnati of commanding influence, the commissioners have thought proper to invite this association to nominate an expert to act with their committees so that the action taken or the judgment given by the expert would command the respect of the electrical fraternity throughout the country, and in behalf of that telegram, I move you, sir, that the president be authorized to appoint such an expert to co-operate with the commissioners of the exhibition.

Mr. Lynch: While deeply sensible of the compliment conveyed to us by the gentleman from Cincinnati, I think we are going very much out of our province in sending a delegate there to determine upon the question upon who shall take priority as regards successful apparatus at Cincinnati. It is something we have never done heretofore.

The President: As I understand it, Mr. Foote's motion is not seconded. Did I hear a second to Mr. Foote's motion? If not, the question is not before the house, and the matter is laid on the table. If there are any original motions or resolutions you can bring them forward, as we have finished the entire order of business excepting electric motors

Mr. DeCamp: I beg to offer the following:

"Whereas, as the value of capital is determined by the profits realized thereon,

"Whereas, The risk attending the business of electric lighting make it pre-eminently necessary that its capital be surrounded with such safeguards as will protect it against illegitimate competition,

"Whereas, The practice of parent companies of furnishing apparatus and capital for the establishment of plants in cities and towns where local capital has already been invested is a growing evil; therefore be it

"*Resolved*, That this association denounce such practice as detrimental to a common interest, and recommend its members jointly and individually to suppress it even to the extent of discriminating against all systems which persist in such practice."

Mr. Weeks: I move the adoption of the resolution.

Mr. DeCamp: I want to speak to that resolution briefly.

The President: I guess, Mr. DeCamp, before we go any further I will have to call a three-minute time on every man.

Mr. DeCamp: Very well; I am not much of a judge of time. At Baltimore there was a resolution passed and a committee appointed on that very subject. There was a report made at one time that the committee had found little or nothing to do. In the last year or two I have heard very little of that evil, but since I have been attending this convention there has been one case specially named in which there is an absolute evidence of all the facts in the case. It simply comes down to this: A parent company will by any means they can, legitimately, of course, invite local capital to establish plant and you know that they only get that capital and establish those plants on representations they have made as to the return on the capital invested. They succeed in doing that. That has been the growth of the electric lighting business. No sooner is that done than they offer, probably indirectly, but nevertheless with the same effect to loan to city authorities and other companies who are ambitious, both material and money to compete for public lighting. What is the result? I hear of public lights being offered at 12½ and 15 cents. That is the most downright robbery on the part of parent companies that can be conceived of. If they know anything at all they know that there is no apparatus that will produce light for that price, and I do not think any action this convention can take will be too severe on any such party.

Mr. Ridlon: In regard to the committee Mr. DeCamp refers to and the action that was taken at Baltimore, that committee did call on a parent company who thereupon acknowledged their error and promised not to repeat it. It has been repeated now and fully as severely as it was done in the first place, and as Mr. DeCamp says it certainly deserves a censure from this association.

The resolution was carried.

The President: The chair will appoint as a committee on education, so that there may be no dispute in regard to the chairman: Dr. Moses, Mr. Weeks and Mr. Foote. We are now prepared to take up the question of distribution of power by motor service.—Mr. Lufkin.

A Basis from which to Calculate Charges for Electric Motor Service.

By H. F. Lufkin.

The theoretical side of the electric motor question has been very ably presented to and discussed by this association, but thus far the practical side has been somewhat neglected. It will be my purpose in this paper, if possible, to show that there is a general average controlling the use of machinery which it will be safe for electric light and power companies to follow in making their charges for motor service rather than adopt an arbitrary price for horse power regardless of the character of service required of the motor.

I have arranged what might be called a power curve, representing the approximate average actual service in electric motors in connection with the several classes of work represented in the list accompanying the diagram. This curve is calculated on motors which are only of sufficient

capacity in each case to carry the full load. If the motor should be larger than is necessary to drive the machinery the percentage of actual service will of course drop below that shown in the diagram.

By adopting a basis of averages which shall be general among members of this association the charges for a constant horse power of current may vary with the circumstances of its first cost in each case, but the general classification of motor service may be a comparatively fixed rule. I am not prepared to say that this is the best plan to follow, but respectfully submit the following as a possible solution of the frequently asked question: "How shall we charge for electric motor service?"

First on the list of power consumers is the exhaust fan, taking it in average use. There are, however, circumstances under which its use will be limited to as low as 70 or 75 per cent. of its contract hours of service. As for instance, in a dining room it may be cut out except during meal hours, or entirely cut out on cool days In places of this description, however, its contract use is usually limited to three or four months in the year, and other than electric power is by circumstances of first cost and inconvenience, but a feeble competitor. The first four applications on the accompanying list, viz.: Exhaust fans, blowers, ceiling fans and fan outfits are all more or less subject to the foregoing conditions, and therefore current supplied to motors for these purposes commands the maximum price per horse power. One important feature in the installation of ceiling fans is the counter shafting to the motor. In one recent case we had a complaint from a customer that the ½-horse power motor sent him would not drive two ceiling fans, and that the motor must be defective, and should he return it for repairs. We immediately sent a representative to find the difficulty, which was found, as is usual in such cases, in the counter shafting, or rather the want of it. The three-inch pulley on the motor was connected to a six-inch pulley on the line shafting. The rated speed of the motor was 2,000 revolutions, and had it been able to develop this speed would have driven the line shaft 1,000 revolutions and the fans at a relative speed. To accomplish this would probably require a motor of three or four horse power. The line shafting driving ceiling fans usually runs about seventy-five revolutions. To give this speed on the line shaft with a rated speed of 2,000 on the three-inch pulley of the motor would require a counter shaft with a twenty-four-inch pulley belted to the motor. On this same counter shaft should be a five-inch pulley belted to a fifteen or sixteen-inch pulley on the line shaft. Fully three-fourths of the trouble found in electric motors arises from improper shafting and belting. The average make of thirty-inch exhaust wheel, a ½-horse power motor, should drive about 400 revolutions. Say then the speed of the motor is 2,000 and the pulley three inches, it would require a fifteen-inch pulley on the fan to do the work; a thirty six inch wheel requires one horse power to develop the same speed. If the motor speed is 1,800, the pulley four inches, it would require an eighteen-inch pulley on the fan to do the work. These are the most popular sizes of exhaust wheels.

The next application on the list, open tank elevator pumps, commands the highest price for current per horse power in the motor of any elevator application. The methods of operating the open tank hydraulic elevators in question are undoubtedly familiar to you all. Instead of the usual steam pump, a power pump of some approved design is substituted and connected to the motor by suitable counter shafting to give the required revolutions at the pump. The regulation of the motor in this case should be controlled by the position of water in the lower tank as in the case of the steam pump. And in this connection let me suggest the necessity of great care, both in installation and insulation. On all installations in basements and cellars, or elsewhere where there is the slightest tendency to dampness, raise the motor off the floor on a suitable frame or stand, and build around it on all sides of possible approach a low platform, using glass insulators as legs or standards to support it. So arrange this that the motor or its connections cannot be reached except when standing on this insulated platform, and the liability to a shock will be reduced to the difference of potential between the terminals of the machine. To return to the subject. Let us take for an illustration an elevator using 120 gallons of water per trip, and consuming one minute in making its entire up trip, or about two minutes per round trip; the lower tank or water supply is on a level with the pump; the upper tank is seventy feet above the pump, and in the piping to the upper tank are five elbows; for each elbow add two feet to the elevation, or an approximate total elevation of eighty feet by 120 gallons, which gives us 9,600 foot-gallons This amount would be required every two minutes if the elevator was in absolutely constant operation, or 4,800 foot-gallons per minute by 8⅓ gives us 40,800 foot-pounds. This we must at least double to allow for friction in pump, shafting, etc., making 81,600 foot-pounds, or about 2½ horse power, say three, required in the motor.

This class of elevator is confined almost entirely to passenger use, therefore the service required of the motor is much more constant, and the margin between the horse power-hours contracted for and the horse power hours of actual service much smaller than in any other elevator use, excepting possibly the services in connection with pressure tank elevators in the more popular office buildings In this case we have a maximum average use of eighty, and instances such as the hotels, small office buildings, etc., where the service will not exceed sixty of the contract horse power-hours. In order, however, that the electric light company shall derive the greatest benefit from this inconstant service the installation and wiring should be the best and only the most approved and economical apparatus employed.

The next application on our list, pressure tank pumps in connection with elevators, represents a somewhat smaller percentage of horse power-hours of actual service in the motor, as compared with the possible horse power-hours, than in the case of an open tank pump. In case of the pressure tank the water reserve is usually limited, and the motor, therefore, must be equal to the continuous operation of the elevator at maximum load. Taking this fact into consideration, and the circumstances of elevator use being about the same in this case as in case of the open tank elevator, we have a greater ratio of difference between the possible or contract horse power-hours in the motor and the horse power-hours of actual service, the maximum average use being about 70 to 75 per cent and the minimum as low as 35 to 40 per cent., depending of course on the character of building in which the elevator is employed, or the character of service In calculating the size of motor required on an elevator of this description a very convenient fact to remember is that every pound of pressure per square inch is equivalent to lifting water about 23 feet, or about 230 feet per 100 pounds' pressure. By reducing the required pressure to a relative lift in feet, and knowing the amount of water required by the elevator per minute, the motor calculation becomes the same, as in case of the open tank elevator, the same allowance being made for friction, etc., as in the first case. The regulation of the motor in this case should be accomplished by the conditions of pressure in the pressure tank, as is the case with a steam pump employed in this service.

The next application of importance on the list is sewing machines. In the tests I have been able to make on this class of work I have obtained some singular results. One item of importance is the fact that the single thread machines, which are the lightest running, consume the most power in operating. Paradoxical as this story may seem, it is easily explained As a rule this class of machine is used on light work, such as shirts, ladies' underwear, etc, and operated at a higher speed than any other class of machine. At equal speed the volts consumed on a single thread machine, as compared with a shuttle machine, is about as two to three. In average commercial use, however, the positions are reversed, and the ratio of volts consumed in the single thread, as compared with the shuttle machine, is about as five to three. To double the speed on a sewing machine requires about two and a half times the power The difference in volts consumed on the different makes of sewing machines is so small that we may disregard it entirely, as well as the character of work done by the machine, for the heavier the work the slower the speed and more frequent and longer stops on the machine, thus keeping the average volts per operator about constant in all cases. This leaves the speed in stitches per minute at the sewing machine the factor from which we must calculate the power required in a sewing machine plant. To illustrate this I will give you the record of two cases, which are about the average: Case No. 1 is a shop in which are thirty sewing machines connected to a two horse power motor. At the time the tests were made there were but twenty operators at work, leaving ten idle machines, the entire shafting, however, being in operation. The class of goods manufactured in this shop is a cheap grade of cotton and wool pants—rather heavy goods to sew. A voltmeter across the terminals of the motor gave the following readings with the current at nine amperes: Minimum, 90 volts; maximum, 148 volts; average, 119, which gives us a minimum average per operator of 4.5 volts and a maximum average of 7.4 volts, or a general average of 5.9 volts per operator. This motor was driving the shafting for thirty machines, and as the average operators employed the year round will not exceed 75 per cent. of the shop capacity, it will, I think, be entirely fair to estimate the average volts per machine rather than per operator, as the user of the motor has contracted for power sufficient to drive his entire plant. In this case then we have a minimum average of 3 volts per machine and a maximum of 4.9 volts, or a general average of say 4 volts per machine. A two-horse power motor of 82 per cent. efficiency, with nine amperes of current, will require about 200 volts to develop two actual horse-power. Two hundred volts, therefore, is what the electric light company contracts to deliver, while in reality they deliver only 129 volts, or 60 per cent., or a minimum average of 90 volts, or 45 per cent. of the power contracted for. These machines were making about 1,200 stitches per minute—an average of 4 volts per 100 stitches.

Case No 2 is a shop in which there are thirty-two machines running at about 1,200 stitches, each being supplied with an individual motor of ⅛-horse power capacity, and the class of goods manufactured being men's summer clothing, such as white duck vests, flannel coats and vests, etc, the duck from which these vests are made being about as hard work on a sewing machine as can be found. In this shop were twenty-four operators at work. The maximum volts in this case were 116 and the minimum 40, or general average of but 78 volts, or about 2½ volts per machine, with four more operators than in the first case, in which we had an average of 119 volts. This shop has been paying the electric light company $32 per month for more than a year, which is the price the same company charge for current for a four-horse power motor, which approximates 400 volts, the company contracts to deliver. This gives us a minimum average use of but 10 per cent. and a maximum of 20 per cent., with a general average of 19⅓ per cent. In other words, the company is saving in this shop the price of ⅛-horse power motor each month, besides making a profit on the volts actually delivered. On a contract for three years the electric light company would be money in pocket if they would present the customer with thirty small motors, charging him $1 per month per motor for current, rather than let him buy a two-horse power motor to operate the same machines, with the necessary shafting, at a charge of $18 per month for current. Taking this average in case No. 2 of 2½ volts per machine, from a 50-light machine we could run not less than 900 sewing machines, or about eighteen to the arc lamp. At $1 per month per machine an income of $900 per month would be derived from a 50-light machine without any lamp expenses, such as carbons, repairs on lamps, globes, etc. On the average in case No. 1 of four volts per machine we could operate but about 562, say 600 machines. Divided up in shops of thirty machines, and a two-horse power motor to each shop, we would have twenty two-horse power motors. At a charge of $18 per month each we would have an earning capacity of but $360 per month from the same 50-light machine.

This is but one page from the thus far unwritten history of the much maligned small motor. Still the question is frequently asked, "Can we sell current for $1 per month for a small motor driving a sewing machine and make a profit?' As a matter of fact 50 cents per month for small motors driving sewing machines yields a better profit to the company supplying the current than $10 per month per horse power in large motors to drive the same machines, besides the immense advantage which the small motors possess of keeping the circuit in much better balance, the fluctuations due to the stopping and starting of large motors being at times a serious matter. One electric light company, making rather a specialty of these small machines, rents the motor and supplies the current for $1.25 per month per sewing machine, and reports that at this price the motor service pays a better percentage of profit than lamps. This company has some 200 small motors on its circuits.

A more striking illustration of the advantages the electric light company in the subdivision of power into the smallest possible units it would be hard to find. There is a difference in efficiency of from 15 to 20 per cent. in these two sizes of motors, but this difference is fully lost to the large motor in driving the shafting, and the small motor still has the advantage of being out of circuit entirely when the machine it is driving is stopped. There is scarcely a manufacturing industry which does not possess its busy and dull seasons. This means that in no industry will over 75 per cent. of the machines or machinery employed be in average operation The entire shafting in the shops must be kept in operation the entire year often for less than 50 per cent. of the machinery. Subdivide these same shops into as many small units as possible and the current necessary to operate the shafting for this idle machinery will be saved, besides the saving from frequent stops while the machinery is in active use.

To return again to the list, the next two applications, picture frame manufacturers and molding manufacturers, are very similar. Their busy seasons as a rule are in the spring and fall, and also follow closely any activity in house building. In the case of the larger manufacturers in this line a maximum average of 75 per cent. will possibly be reached, but probably never exceeded. In the case, however, of the picture dealer who has a small shop in which he makes picture frames and moldings to order the actual service of the motor will fall as low as 25 or 30 per cent. of its contract hours—one case in our experience the actual service having reached this low average. A fair general average in this class of works would be about 60 per cent.

The next application, nickel and silver platers and buffers, are good contract customers as a rule, one case in our experience showing but an average use of 20 per cent. of the contract horse power hours. This, however, is probably an exceptional case, and as nearly as we can estimate on this class of work the actual motor service will not exceed in any case 60 per cent. of the contract hours, a fair average being probably 45 or 50 per cent.

The next two applications, printing presses on news and job work, are probably met with more frequently than any other On exclusively news work the instances where the motor is in service more than three or four hours, is rare. It is, however, usual in news offices to find two or more job presses. If the newspaper printed happens to be a morning paper the hours of news work are usually between midnight and 4 o'clock in the morning, the job work being done through the day. I have in mind a case of this description. In the shop is one cylinder press and three job presses connected to a two horse power motor. This motor is on an incandescent circuit of 110 volts. To develop its rated power at 110 volts would require about sixteen amperes in the motor. An ampere meter in series with the motor while running off the morning paper, with only the cylinder press in operation, stood at twelve amperes. For three hours this load was practically constant, when it was thrown off entirely. This gave on the night service but 30 per cent of the contract hours. This motor required five amperes to drive the shafting, and but eight amperes or one horse power to drive the three job presses, with the cylinder press off. Here then is but a 50 per cent. use if the presses be used constantly. There are, however, many days when they are comparatively idle; 30 to 40 per cent., therefore, is a very safe estimate of the maximum use of this motor on the day circuit; or had the motor been a one horse power, which would have been sufficient to drive the job presses, the use would be 60 to 80 per cent. of the contract hours—probably not above 60 per cent. All printing offices will probably come within this range unless the motor be larger than is necessary to do the work.

Machine shops doing principally lathe work as a matter of course use a larger percentage of their contracted power than shops doing lathe and bench work with the same hands In no case will the service of the motor exceed 65 or 70 per cent of its contract use, for machine shops, like sewing machine shops, will never average over 75 per cent of the shop capacity for operators the year round. The average, especially in the case of a shop doing much bench work, will fall as low as 40 per cent

The driving of laundry machinery, which is our next application, usually proves a profitable contract, according to reports This fact arises from the intermittent use of the machinery. The heaviest service on the motor will probably be found during the early part of each week, with a general falling off in work during the summer months while the patrons of the laundry are away at the seashore or in the mountains. In this application, therefore, a 75 per cent. service would probably be an exception, with probably many instances where the service would fall below 50 per cent.

The next application, model and pattern makers, are small users of power, as their occupation requires a large

proportion of hand work. Fifty per cent. service in the motor will be found a fair average maximum use, with instances as low as 20 or 25 per cent

The next application, direct power or belt elevators is another application frequently met. The average service in the motor is also much smaller than in any other elevator application. Let us suppose a case of the familiar grip connected to the ordinary hand hoist with a lifting capacity of 2,000 pounds. In this case the motor is in use only going up, and the usual brake is used in coming down Connected to this elevator in the loft of the building we have a 5-horse power motor wired to a cut out on the ground floor. We will call the lift 45 feet and the time consumed per trip one minute. We will allow sixty full trips of the elevator at full load at 2,000 pounds per trip each day. This would approximate ten car loads of merchandise handled by the elevator, which is certainly above the average. This motor we will say is on a ten hour day circuit, its possible horse power hours therefore would be 5-horse power for ten hours or 50-horse power hours per day. Sixty trips of one minute each give exactly one hour's service of the full 5-horse power. or 5 horse power hours. To drive the shafting only while the elevator is coming down or idle, would require about 150 volts or 1½-horse power, and if this was in constant operation the balance of the day, nine hours, its total use on shafting would be 13½-horse power hours, which added to the 5-horse power hours, gives us a grand total of 18½ horse power hours or 37 per cent. of the contract hours. If, however, the user of the motor avails himself of the cut out box, and cuts the current out when the motor is not in use, the average use would drop to 20 or 25 per cent. instead of 37 per cent In the case of a direct power passenger elevator the use might possibly run up to 60 per cent , but this would be exceptional.

Coffee mills will average from 40 to 60 per cent. of their contract hours; manufacturing jewelers about the same, while retail jewelers will run as low as 25 per cent. Ice-cream freezers will not average over 25 per cent., but as the contract season in this case is unusually short they should be rated at least a 50 per cent. basis, except possibly in cases where the customer pays the cost of installation and wiring which is usual in these cases A dentist is one of the smallest of power users, so small in fact, that if every one in the city were connected with a circuit the load from this cause would never be felt. We will, however, put them down at from 10 to 20 per cent

The optician uses a motor to turn his grain stones and its use in this case will average from 20 to 30 per cent. The last application on the list, church organs, use only from 10 to 20 per cent of the contract service. These are, of course, but few of the very many applications of the electric motor, and if, as I trust, the possibly subsequent discussion of this general plan may establish a basis for rating motor applications, not only will the objects of this paper be obtained but a question of considerable annoyance now existing between the motor man and the electric light or power company, will be solved.

In conclusion, Mr Chairman, I beg to suggest that the supply and rates of charge for electric power have become of sufficient importance to this association to be represented by a permanent committee, whose duty it should be to obtain from different members of the association, as far as possible their experience in the supply of power, in such manner and form as shall be deemed by the committee best suited to the wants of this association.

THE PRESIDENT: The paper is now before you for discussion. You will have for the consideration of that topic just one hour, so that everybody must get right into the merits of this discussion promptly.

F. R. COLVIN: The paper that has just been read is very interesting to all the electric light people, and it should appeal and does appeal to all electric lighting people who have or contemplate having power service, with the irresistible eloquence of dollars and cents. The first thing to consider is whether they will use power; yes, can they make it pay? Well, it is according to the charge for power. If they charge too much every gas engine will get ahead of the motor. If they charge too little the power business will not pay. If they adopt a cast iron rule, and charge so much a month for everything, they do an injustice to intermittent power, and if they have a sliding scale the next city will have a different sliding scale, the customers will get together, and the consequence will be dissatisfaction all around. The paper presented brings up one recommendation of a solution of that problem of classification. I think every one realizes how important that is As far as the suggestion of small motors is concerned and their advantage over large ones, the writer says this is but one phase of the much maligned small motor It is very true. The other phase is that companies starting power usually have an idea that the fan business is the great end of all motor service, and they commence with small power. When they put in larger powers they find the larger motors require less inspection than the small ones. The brushes of the small motors require more frequent adjustment. The small motors in the case of sewing machines have to be opposite the machine and exposed, whereas the large motors can be put in a safe place. If anything can be learned of results by visiting a city where electrical power has long been in use, you will find, if they have used large power, that they will prefer having a six, eight or ten power motor than a number of small motors.

Another thing: Granting the fact that the small motors do take up a great deal of time and require frequent adjustment, that very fact jeopardizes the satisfaction of the customer. These things deduced theoretically are frequently reversed in practice. Take the case where the gentleman figured out that the company could afford to present the manufacturer with thirty motors. He could if the thirty motors would run without any trouble. But my experience with both kinds of motors has been that I might get in trouble in that way and have some of those small motors give out, even one or two of them, and I might have the thirty motors back on my hands. In the case of small motors again, there are more sliding contacts of the brush and the commutator, more binding posts shaken loose, more broken adjustments, more money for repairs per horse power—infinitely more money. As I said before, the large motor, if it is an arc motor with a high tension current, can be placed away from the operating room entirely, where it can only be reached by the inspector. As far as economy is concerned, if the motor is so constructed that the amount of current it consumes shall be a function of the work that it does, of course you will have shafting against the large motor but you will have the satisfaction against the small motor. I do not mean to say that small motors are not successful, but I mean that the average experience is that there has been more trouble with small motors than with large ones. Large motors, as a rule, if they are properly constructed, govern better, require less attention, and give better satisfaction. In fact the most efficient, satisfactory and paying service in my experience is where large motors have been used. I think every one appreciates the necessity of having some definite classification of this sort. It is needed all the time. In visiting a city and talking power with people, it is almost impossible to get on a scale. I know of a place in the south I visited the other day, where a customer told me he was getting electric power very cheap. I inquired what he was paying; he said he was getting it for $20 a month. It was a half horse power. His water power used to cost him more. In other places they will growl at $4 a month. If there was some system, so that it would be uniform, I think it would be money in the pockets of the electric lighting companies, and would certainly tend to advance the business.

MR. HARDING: There are very many valuable points in the paper which was read, and I hope that the managers and presidents of all the electric light companies will read it over very carefully. It shows a good deal of thought. The true way to charge for power is to classify the work By doing that, and carrying it out even a little farther than it is done there, each electric station manager will then know just what he should charge, and the moment he feels confident, when he signs his name to a year's contract, that he is going to make money, there will be no trouble in placing motors. In regard to small motors being more economical than large ones, it may be I do not get the figures exactly right, but taking them as he gave them with his large motor, he was running fourteen sewing machines to the horse power. Now you could easily man with one horse power twenty sewing machines, and even above that. He compares a motor which is only driving fourteen sewing machines, with his small motor. Probably he lost very much power in his counter shafting. That is what I should judge There is one other point of the business which you all find, I think, of a good deal of interest and value, and it is a new branch that has come up on an extended scale, almost since the last meeting; that is central stations supplying power to run electric railways. The central stations in each case could do that. You can make up your mind that if a street railway company put up a large central station to run their cars they are going to supply light and power. You may say their charter will not permit that Probably not; but at the same time the same men may form among themselves a second company. In order to prevent that, it is necessary for you to furnish power to run their railways at a reasonable rate. You must remember that a street car will be operated fully sixteen hours a day. In the city of Richmond they are taking about five to six horse power per car. That is an exceptionally difficult road to operate, having grades as high as 10 1-10 per cent., curves 27 feet radius, and other details which make it very difficult. You can therefore take it as a certainty that it will not require, on an average, for your sixteen hours a day, over five horse power, and from that you can calculate what you should charge. A few data referring to that may be of advantage. In Wilmington, Del , they are running now three cars, to be increased to ten. They charge $2.50 per day per car. In Carbondale, where they only pay ten cents a ton for their fuel, using the screenings, they will run any number of cars, up to six, for $7.00 a day. In Brockton, Mass., the price is about $1.75 per car per day. In Richmond the cost is a sort of a compound arrangement, because they are supplying light as well as power from the same station, and they estimate that they will charge the railway company $1.68 per day per car. In a neighborhood where coal costs $3 and $4 a ton, and the cars run sixteen hours, the charge would be somewhere between $1 75 and $2.50 per day. I present these facts because I think the question will come up before long to most of you in regard to supplying power for the railways in local places. In some of the large cities where the service will be through an underground conduit, the electric companies are considering that they will supply seven, eight or ten horse power to operate the road, and they are willing to make such a rate that the railway can afford to take their power from them rather than put up their own station. Of course in that case the margin of profit would not be as large as in the other case.

THE PRESIDENT: Mr. Ridlon, give us some of the facts in New England cities.

MR. RIDLON: I have had but very little experience in the matter of selling power, and have been but a comparatively short time in the motor business I fail to understand the gentleman's theory thoroughly in regard to the economy of small motors. In all other branches of machinery we have always found that where the power was even, a large engine would operate more economically than the small one. I have found it in motors the same. In the first place it takes out one set of wires. You can connect it with the outside lines as cheaply for a ten horse power motor as for a half power motor. The inspection for a ten horse power motor costs no more than a half horse power motor. It simply consists in trimming the brushes and seeing that the governor and everything connected with it are running satisfactorily. I have found by actual experience that a man who was using a fifteen horse power engine, and thought that he wanted fifteen horse power to drive his machinery, was not only perfectly satisfied with the power he got from a ten horse power motor, but thought he had some to spare, and that he could do even with less. The question that has come up here in regard to the regulation of price for power, that is, charging for what average power is required, seems to me a very important one; that is a question on which hinges a very large portion of the future motor business, getting down to the fact of the amount of power which the customer is using, and the sooner that we can get any actual data in regard to those facts before our association and before our electric light companies, the sooner we can increase the volume of our motor business. I hoped in this discussion that we would hear not especially from the motor men, but from the people also who are furnishing the current to the parties using the motors; and I hope this discussion will not close until we have heard from some of the superintendents or managers of the central stations throughout the different parts of the country.

THE PRESIDENT: Gentlemen, we have heard so far in the discussion from the manufacturers' standpoint more than from the standpoint of the practical operation of a power station. I should like to hear from somebody who is selling power.

MR. REDMOND: We rent 296 motors. We receive $18 for one eighth; $48 for one half; $72 for one horse power; $225 for four horse power; $300 for six horse power; $325 for eight horse power. Of course you understand we run all by water, and do not use any coal

THE PRESIDENT: Are there any others present who can give us some information of that kind, which we would like to receive? It is very interesting to compare the prices, and find out what the opinion is of those who operate stations I should like to hear from the Philadelphia company.

MR. REDMOND: I would state I have a one-eighth horse power motor running an elevator, and we find that the average time is not more than 20 per cent.

MR. RIDLON: I would state in regard to the question of water power that of course that matter would hardly be understood by the steam power people. I am now making arrangements in Maine where the parties will make a very handsome profit and one that will bring smiles to the faces of most of the members here should I state them.

THE PRESIDENT: It would be a good idea to have those figures. There has not been much smiling this morning

MR RIDLON: They figure their horse power at $25 a day I would state the fact that a horse power costs them $2 50 per day, and they have got four or five thousand horse power.

MR. LUFKIN: I would like to say, in reply to Mr. Colvin, that I think he rather exaggerates the expense of repairing small motors. In the case of one shop which I referred to, where they had thirty-two small motors in operation, I took pains, the other day, to look up the repairs for the past year. There have been but two commutators burned out, out of thirty-two machines, and no armature has given out. There has been no accident in the shop of any kind from any cause, and the service is reported by the people using the machine as very satisfactory. I do not mean to argue that an eighth of a horse power motor is the only motor that can be used, by any means, but the profit of the electric lighting company arises largely in subdividing their power—in suiting the motor to the emergency in each case.

MR COLVIN: I would like to ask the gentleman if those were run by incandescent lines or arc lines?

MR. LUFKIN: They were on a Brush arc circuit

MR. COLVIN: Were they run all the time during the year?

MR. LUFKIN: Right through the year.

MR. COLVIN: Did they carry the full 9 6-10 current?

MR. LUFKIN: I understand so. The current in this case is a trifle under 9 6-10. I should say it is about 9 amperes.

MR COLVIN: The reason I ask that question is, that many motors with which I am familiar owe their length of life to the fact that, although they run 9 6-10 in the night, they run 8 and 8½ all day. You never hear of a case of fields burning out My remarks about small motors were simply from experience of fifteen or twenty cities where different types of motors were used. I know one or two motors of a very small size that have run better than large ones; yet, it seems to me, they were exceptional. What I stated was simply my average experience and from what those electric light companies told me, and also from their anxiety to get larger sized motors and larger generators on the market.

MR. LUFKIN: I think that is rather from a lack of the appreciation of the merits of the case. I think that as soon as the question is thoroughly understood by the electric lighting people they will take in these small motors, and they will be more ready to adopt a scale, such as I have suggested, for selling power.

MR. COLVIN: My idea was simply to bring out the fact that a thing which may appear theoretically clear and overwhelming, as in the case of nine inventions out of ten that go into the Patent Office, there may yet be some subtle reason in practice why it may not be so.

THE PRESIDENT: Mr. Law, we would like to hear from you on the question of the distribution of power to motor service

MR LAW: I do not know that I have got so very much to say on that subject, although we were, perhaps, the pioneers in the distribution of power by motors. Our first experience was entirely with small motors. Certainly looking at it from the standpoint of a company furnishing power, and the prices that we are getting for those motors, there is more money in the smaller ones than in the larger ones, besides their not being as hard on the dynamo, as Mr. Lufkin has stated in his paper. We have no very large motors in Philadelphia. Perhaps the largest one is a five-horse motor, running a saw, as an exhibition. That is a very poor thing to use as a basis for figuring on motors for fan work. It is steady work from morning till night, and sometimes from morning to morning It is a direct drag upon the current. We have but very few motors for intermittent work. We have two on printing presses, and in all cases, I think, the motors that are doing that work have come out to the premises of the company putting them in.

We only furnish a current for the motors. We have nothing to do with the motors themselves, except to l ring the wire to them. Once a month, however, we make a round of all the motor places and inspect their condition, and see if there are any changes in the amount of current consumed by the motor.

THE PRESIDENT: Gentlemen, if there is no further discussion on this subject, we will proceed to the closing part of our programme, but I want to say that I am exceedingly disappointed at the meager discussion which has taken place on this question of the distribution of power. It is, to my mind, the most important development at the present time in electric interests. If you will look around you and see the amount of capital that the various companies have put into this business in the last six months alone, you will find that it is something enormous, and you will find that companies are not only going into it with the idea of applying motors of two, three, five, ten, fifteen and twenty horse power, but they are going into it with the idea of developing and furnishing power up to 100 horse power in motor service, and they propose to have, and are making, generators to supply that power, to make it a special service, and not only that, but the increase of the factories already in operation is such as to warrant the belief that they will within the near future be supplying generators of even larger capacity than those named. If that is the case—if this development is going on, and the money is forthcoming for enterprises of this kind, it shows that the people who are putting this money in have entire confidence in the development of this business. That leads to another fact—that if they are putting their money into them, they know there is to be an outcome and a future to these enterprises. That means that we shall have stations which will employ, probably 5,000 or 10,000 horse power as centers of distribution. We go a step further, and those centers of distribution furnish not only power for motor service, but they furnish power for railway service, and may not only furnish power for railway service, but if the electric lighting companies do not take up this question, these very companies, formed originally for power distribution, will take up electric lighting. Now, that is the way it presents itself to my mind, and I had hoped that when this question came before this association this afternoon the chair would hardly be able to bold down the number of people who would spring up all over the house and want to talk at the same time.

MR. RIDLON: With yourself, Mr. Chairman, I am very much dissatified at not having heard more discussion upon this subject, because I expected electric light companies would come out and make statements in respect to the profits of the power business as compared with the profits of lighting. One thing I know to be a fact; there is quite a gain in that direction. The power sold to the customer who uses the motor costs the electric light people far less discount in their bills, gives them far less trouble, and they do not have to exercise that care or inspection that they have to with the lamps. I think one company in Boston have had one dollar discount on the question of furnishing power, where they have had twenty on the question of furnishing the same power for light.

MR. GARRATT: I was much interested in the remarks of Mr. Harding, but I was called out of the room and did not fully hear them. I want to know if I am correct in my understanding, and if we can draw a general statement as to the power required for cars. I understood Mr. Harding to say that cars are run on an average of sixteen hours a day, and on an average of 5 horse power. That means 80 horse power-hours per day. Multiplied by 365—for cars run for 365 days a year—that makes 29,200 horse power-hours a year. I would ask Mr. Harding if it would be a fair statement to say that 30,000 horse power-hours per year, in round numbers, would run a car.

MR. HARDING: I think that would be a perfectly safe figure. The only excess might be that in certain cities they are liable to run one car possibly after twelve at night. In order that there may be no misunderstanding I would say that I was taking this condition: That the station was already established, and had its engineers and firemen, and this was the additional expense for operating the street cars. I did not mean that the company put in this station and pay its engineers and firemen to accomplish this result. This was the additional expense of running cars from the central station.

MR. GARRATT: I understood that. I also understood Mr. Harding to say that an electric light station could afford to furnish a current for those 80-horse power hours per day for about $2 per day, that would mean $730 a year for a car. Let us put it in round figures—that wherever a local company wants to put in a free motor we can say we will let you have this for $800 a year for a car. Would that be a fair statement?

MR. HARDING: Yes, sir.

MR. RIDLON: I will say for the benefit of Mr Harding's company that I was at Richmond with the West End railroad people at the time they investigated the question of electric railway service, and they were very much surprised at the low cost at which that power was furnished there per car. They could not possibly believe it, although I can see very plainly that it is a matter of fact, they compared it with running horse railways, and they calculated it cost to feed a horse what it would take to run one of those cars a day—$2 a day, where it cost only $1.60 for the power from the electric light station; and that did not allow anything for the cleaning of the horses or to the harness or the wear and tear of harness, or interest on amount invested for shoeing, or any other matters; but simply giving him his hay and grain

MR. DELAND: Referring to the paper by Mr Leonard, of Minneapolis, on the use of petroleum as a fuel, Mr. Hart has kindly given me some data which may be of service, when we consider that his experience runs over nine months. It appears that the actual savings are over fifty per cent. in the use of oil fuel over coal. The data given me is this: They have been using first quality Pittsburgh nut coal floated down the Ohio and Mississippi rivers costing $4 50 per ton laid at furnace door. The portion of coal that usually goes to waste costs 25 cents a barrel at Findley or Lima and 75 cents at the furnace. As three barrels of oil replace a ton of coal the saving is fifty per cent. There is no burning out of grate bars, no removal of ashes, no smoke in the boiler room. Mr. Hart said that the only disadvantage that they labored under was in respect to transportation. This difficulty they proposed to do away with by the construction of their own tank floats and depots. This company had their own tank costing $14,000. The oil flows from the cars into the receiving tanks, is pumped into reservoirs, passing thence through pipes under the boiler. When the oil is turned on a jet of steam is made to spread the oil flames, so that cold water is converted into steam in twenty minutes or less time. You will remember that the question of the burning out of the grate bars came up during the discussion of Mr. Leonard's paper. Mr. Hart tells me that he has replaced the grate bars with brick, so that there is a saving effected in that respect. Regarding the injury that might result to boilers, the fact that the inspector of a boiler company was down there a few weeks ago and approved their system and congratulated them on their success would show that there is very little probability of such injury. Mr. Hart has also kindly sent large photographs of their dynamo room, their furnace room, their engine room, and other parts of their large plant, and they are now in the parlor occupied by the WESTERN ELECTRICIAN.

THE PRESIDENT: I am exceedingly sorry that I did not know that the gentleman had that information or I would have called upon him. We are much obliged for this information.

MR. DELAND: I would say, Mr. President, the thanks are due for these data to Morris J. Hart and Simon Hart.

THE PRESIDENT: Gentlemen, if there is no further discussion on the motor business we will consider that subject as passed. We are now ready for any motion or resolution or any business that may be presented before adjournment.

MR. STEUART: I would like to offer a resolution. During the first hour of the session this morning a very important question was disposed of with, as I think, inadequate consideration. The subject of the work of the New England Electric exchange is one in which I have been very much interested for many reasons. I think it will be of great advantage to electric light companies in giving them competent employes. It also opens a field for honest and meritorious men to find good employment by procuring licenses from such an organization. I believe that during the morning hour the president of the exchange and secretary were absent from the floor, unfortunately. They are now present and I would move you that the action be reconsidered, the question opened for discussion, and the president and secretary be requested to give us their experience and views on the subject.

THE PRESIDENT: Gentlemen, you have heard this motion. If there is no objection to this, we will give these gentlemen just ten minutes of our time. I hear no objection and we shall be very glad to have the gentlemen give their views. The president of the New England exchange is now present and I shall be glad to hear from him.

MR. ALEXANDER: I am very thankful to my friend Mr. Steuart for bringing this matter up again, less because I desire to give any information—I do not know how far you went this morning--but more so to be able to state a grievance that I have. I asked the president of the association last night at what hour that paper would be read. The secretary of the association, the inspector of the New England Insurance exchange were present, and myself. We were very much interested in the subject, and naturally desired to be heard. I have stated to the president the nature of the business that called me away this morning, and begged him to postpone that subject for a little while. I came here at twenty minutes past ten and had no idea until 12 o'clock that it had been disposed of, though I was present here in the room at that time. Naturally I cannot say much, not knowing what the report has been; but I understand that there have been some statements made which the secretary of the exchange, who has labored very hard in the matter, declares were not quite correct. As he knows what these misstatements are I will yield him the floor.

THE PRESIDENT: The chair would just state that the statement of Mr. Alexander in regard to requesting a time to be appointed is correct. The chair will also state for the information of the association that there is not one gentleman who has had a paper before this association but that would like to know the exact minute when it would be presented. The chair would also say that he does not know where gentlemen are to be found at any particular time. The chair would further state that it is the duty of every member of the association to sit in this body from the time of the opening of the first session to the last moment of the last session. That is the only apology the chair has to make for any little inadvertence on his part. If he has failed to accommodate everybody it is simply because he could not look all over the city of New York and put the right man here at the right moment. [Applause.] We shall be very glad to hear from the secretary of the New England exchange.

MR. CRAM: In New England we are pleased, I think I may say, with the Insurance exchange, which has gone to work at the right end of the problem as to the relations existing between the insurance interests and the electrical interests. The electric light committee of the New England Insurance exchange has for its chairman a gentleman who has devoted a great deal of his time to the subject; and from the start that exchange has evinced a very decided interest and determination to bring the insurance interests and the electric light interests into absolute harmony, in order that they may recommend what they believe the facts warrant them in doing, the installation of means of distributing energy by electricity in preference to any way for purposes of illumination or of transmision of power. They have already taken several steps in that direction. They have offered a reduction in rates in certain cases where electric light is used as an illuminant in preference to gas or other means. When the matter of inspection was started, there was naturally more or less inertia, and it was finally discovered from experience that while the Insurance exchange could inspect apparatus and installations it could not inspect men. As a result the New England Electric exchange was formed, to put it very briefly, in order to provide some means for inspecting men. The exchange was formed as a result of a meeting to which the insurance men and the electric light men were invited. The Boston Electric club very kindly tendered the use of its rooms for the first meeting. After the formation of the exchange the New England Insurance exchange in order to give the matter authority said on and after Oct. 1 the New England Insurance exchange would require that all persons engaged in installing or operating electric plants, should hold licenses from the New England Electric exchange. The Boston fire underwriters immediately indorsed that action. In a general way the plan was simply this: A plan of licenses was adopted, as I have already stated. Examiners were to be selected from men possessing theoretical and practical knowledge. The applicants were to be examined and passed upon by those examiners in order that the insurance people should be fully represented and there might in no event be any question of the action of the exchange. It was decided that the inspector of the Insurance exchange should countersign the insurance certificate before it was issued and became a certificate. I mention that fact thus particularly because I have observed that there has been an erroneous opinion existing. It has been thought by some that the New England Electric exchange was simply the New England Insurance exchange and that they proposed to coerce electric light companies and electric power companies. There could be no greater mistake. The object is that the two exchanges should work in harmony, and our experience thus far has shown that while there may possibly be some crudities, nevertheless the plan is a good one and is practicable, and we are fully justified in saying there can be no possible question as to its ultimate success. Wherever a misunderstanding has existed it has been a matter of a very few moments' conversation to correct the misunderstanding. After all that has been said during this convention about the absolute necessity of demonstrating that electrical energy can be safely distributed it goes without saying, it seems to me, that there is an absolute need for some such body as the New England Electrical exchange, I believe that such exchanges should exist throughout the country. I further believe that they can only work in harmony with the insurance interests. I believe there is no other way in which their work can be made obligatory or binding. I believe in that way if it can be made so, and without in any way interfering with the legitimate work of an electric company, whether selling light or power, or with the work or duties of any employe from the highest to the lowest. We have found an increased interest among the employes. They feel that, possessing a license, obtained after passing an examination, that their work will be better respected, that they will have the confidence of their employers, and also the confidence of the public. Our experience teaches us, I would say in conclusion, that we are justified in predicting that after the Electric exchange has had time to fully demonstrate the purposes for which it is organized, there will be less heard throughout the public press of the danger to life and property arising from the electrical distribution of energy. [Applause]

MR. STEUART: I see that the time for the discussion of this subject has passed. Therefore, I shall not attempt to add anything to what has already been said, but only to offer a motion that the committee that made a report today be increased to five members, and be continued, with instructions to bring in a report at the next meeting of this convention upon the desirability of establishing a national exchange in connection with this association, and I would respectfully suggest to the chair that the president and secretary of the New England exchange be made members of that committee.

Mr. Steuart's motion was carried.

DR. MOSES: If there is no further business, I would move to adjourn the convention until three o'clock, when we could assemble in full force at the Electric club, 17 East Twenty second street. It is very important for us to be punctual this afternoon.

The convention then adjourned, reconvening in the parlors of the Electric club at three o'clock, President Duncan presiding.

DR. MOSES: It has been my pleasant duty, ladies and gentlemen, to be the depository of a secret for the last three months. You all know there is a certain pleasure about letting secrets out. It has been the desire of numerous friends of the honored first president of this association to exhibit in some way the esteem that they have for him by giving him something that he might recollect; that would keep them always in mind. This time they have managed, I think, to embody something that will suggest to him a new train of thought every time he looks at it; because a man's mind, after all, is suggestive, and a man can find a world in a drop of water if he has imagiuation enough to see it. There are crystallized in this box all the good feeling, appreciation and good fellowship that have actuated every member of the association toward Frank Morrison. We have tried to embody in this his life, and there is symbolically typified in it something representative of the different phases of his active existence. In the first place we have started with the idea that it should be simple and strong; we have tried to paint this thing in black and white, and we hope that he will read between the lines in it all the good feelings that we have for him. At the risk of being a little prolix I will explain the designs here which represent, ladies and gentlemen, a good deal of hard work on the part of the principal men at Tiffany & Co.'s., who entered into it *con amore*, I assure you. We see on a very simple base a silver box having inscribed upon it this: "Presented to J. Frank Morrison by his friends of the National Electric Light association, New York, August 31, 1888." On this base we have three barrettes, one representing a continuous current machine, the center one an alternating current machine, and the third a machine for the

distribution of electric force. The first one is a Brush machine, and I think in the hands of Frank Morrison it did as much as did anything else to establish the fact that electricity could be distributed from central stations profitably. In the center we have a machine that was brought to the notice of the association at a time when he presided over it, and in the most advantageous way, as I recollect, because he descended from the chair, took the part of the association, and defended it against innovation.

Third and last, but not least, there is a Baxter motor. Mr. Morrison represents the Baxter motor as head, front, president and everything else. It is a means of distributing force into something that he—so typical of him—has at heart—that by a very happy thought on the part of Mr. Whitehouse it has been embodied in a design so appropriate that he thinks of employing it for other purposes. All around you will find the Baxter motor worked up like a Greek honeysuckle. It makes a very beautiful decoration; so that the base of this thing is a Baxter motor. On the faces of this you will see Baltimore, whence Mr. Morrison comes, New York where he receives this token, and on these sides are represented the places where all our conventions have been held—Baltimore, New York, Chicago, Detroit, Boston, Philadelphia, Pittsburgh. By the by I must turn off the switch here in order to get at the key that was introduced to typify in some way Mr. Morrison's connection with telegraphy, and through all the various progress by which he has reached the position of being the first president of the National Electric Light association, which means not only the electric light, but that upon which the electric light shines.

This time, ladies and gentlemen, we present the freedom of this box in a silver box—we have not a gold one to give him. Here, sir, is an insignia of the office that you have wielded so successfully at the head of all our conventions. The National Electric Light association, I think, more than to any one else, owes its existence and successful development to you. It was by means of that little instrument, a symbol of power seldom used except for good, that we would typify you with. We have been ruled by it, and we have frequently kissed the hand that bore the rod. Upon this is an inscription: "J. Frank Morrison, 1885—1888; first president National Electric Light association." Here is something typical of an electric table in order that you may with this in your hand hear yourself in contact with every one whom this is intended to govern. This is an insulator. This, president, must be insulated from all the influences that prevail on the floor of the assembly. (Applause.) And we thought that to have been the best symbol that we could put upon the gavel.

Here, sir, you have a cable surrounding this, which represents strand by strand, that by some attachment of the heart every member of the association is in close contact with you and always on the call. Here is your monogram surrounded by a laurel wreath, which you deserve, each leaf represents, by the skill of the silver beater, an incandescent lamp, and the whole of it blossoms at the top into light. On this side you have an arc light, a Brush arc light which you first tried, I think, in Baltimore, before the public in a successful way, so that I think that we have in this respect typified all your connections with electric light interests, and here is the key of it, which is also the key of our hearts. You will find that it is made of wire, and it is a short circuit to us. (Applause.)

MR. MORRISON: *Mr. President, Ladies and Gentlemen:* They say that the most trying time to the soldier is when he is under fire and cannot shoot back. I take it for granted that those of you who have been brought suddenly into a position of this kind can have some little sympathy with the soldier. The fire of compliments that I have received for the last fifteen minutes is enough to break the nerve of a man of much more self-possession than I. In discharging the duties devolving upon presidents of the Electric Light association I have not always been able to do that which would, as Dr. Moses suggests, make them wish to kiss the hand that wielded the rod. I think they felt more like having that rod themselves a little while sometimes. But a man can discharge a disagreeable duty honestly, and will at the end of it get from all fair-minded men that reward which is almost better than anything else—fair treatment in return. The criticisms of the acts of men who are not fair-minded are not worth anything, and, therefore, we won't consider them at all. My connection with the National Electric Light association has been a very pleasant one. It has been a sort of channel through which I have made friends in every part of the country. It makes no difference whether I am in Maine or Texas, I find members of the National Electric Light association—that organization which was born only four or five years ago. I find friends spread out all over the country, and in every case extending a hearty greeting and a hand of friendship. In that way I feel amply repaid for all the troubles that fall to the lot of a presiding officer. It has made the labor of the president of the National Electric Light asssociation, a labor of love, and the appreciation which the gentlemen of this association have shown for my poor endeavors is ample payment. It was not necessary to have presented me with so valuable a gift to have made me carry the memory of every one of you in the most kindly manner in my heart. The National Electric Light association is still something like a young bear—a good deal of its troubles are ahead of it, and if you have not committed an error to-day in some of your legislation, I think that a new generation will fill the vacant places, which men of our time of life must soon make in the ranks of the membership of the National Electric Light association, and these men taking up the work as we leave it will, turn back to the records of the association, and will find, although it was born in storm, it is now pursuing its mission calmly and harmoniously. This association was born in storm, and under the most peculiar circumstances of suspicion and jealousy. That sounds strange, doesn't it, to you men who are so friendly to each other to-day? The organization of the National Electric Light association was made by men who expecting to gain no benefit were afraid to ignore a call which was made for electric light men to meet in Chicago, for fear some other fellow would get a benefit they did not possess. Yet that most sordid motive has led to the most favorable results.

Only a few hours have slipped through the hand of time since I was made the recipient of the gift and testimonial handed to me on the floor of the association, under one of those occasions which makes it most embarrassing for a man to say what he ought to say; and here I find myself brought face to face with a most expensive gift—the gift of gentlemen to whom I have not always been exactly kind, I believe, though I hope I have been just. You can understand, therefore, that in rummaging through the junkshop of my head for something suitable to say, it is not easy to find the kind of metal you need, so whatever breaks there are in my talk you can just charge to that, and ask yourselves if you would be able to do anything better if you were in my place. My position, I confess, is a most embarrassing one. In the future, if I am on a committee, and I have the honor of presenting to the retiring president of the association a testimonial, I pledge my words of honor I will never place him in such a position. I thank you for your courtesy; I thank you for the kindness you have shown me; I thank you for all the kindness you have shown me during all these years. It is not necessary for me to tell you that I will remember it as long as I live, for I could not possibly forget it if I tried, and I would not if I could.

Before I step back I want again to call your attention to the remark I made a moment ago. Within the next twenty-four months will be determined the question whether the National Electric Light association will become a permanent institution, or whether it will pass away as thousands of other associations have passed away, leaving hardly a trace. This to-day is the strongest electrical organization ever formed in this country. It is not strong in members, but it is strong in its firmness of purpose, and it is strong in the honesty of its members up to the present time, who, I am happy to say, have been able to eliminate every feeling of personal advantage, and have met upon a common footing. Now, with that feeling, I say guard youselves against suspicion, against jealousy, and when ever a question comes up which you will be called upon to decide think first not what will this do for me. You, gentlemen of New York, do not stop to think what it will do for the New York Electric club. You who are engaged in the wire business do not say what will this do to the advantage of my business; but knowing and feeling that neither social organization nor private business can be advanced or live unless you act on the basis of fairness and honesty, when these questions come up, give and take until you get a synchronism along the whole line. This is the first chance of my life I have had a talking before ladies. I have only fear of one [laughter], and she, like the poor spoken of in the Gospel, I have always with me. One of the difficulties of a man untrained in speaking is the difficulty not what to say, but where to stop. I never have been able to find that point, and so have to break off just as abruptly as I do now. Gentlemen, I thank you. [Applause.]

DR. MOSES: There is one other very pleasant duty that has been thrust upon me like greatness upon many men, and if Mr. Byllesby is here, the representative of one of the Westinghouse interests who contributed so pleasantly last spring to entertain us while in Pittsburgh, I would be glad to say to him what I have to say. Well, as our honored president lives in the same town as Mr. Westinghouse, I would be glad to address him; or if the president of the club will accept the gift, or Mr. Westinghouse, it is all right. This, gentlemen, is a little testimonial from the Electric club. I will not say a receipt in full, but a receipt on account of the National Electric Light association for many kindnesses extended by the interests represented by George Westinghouse. The inscription, however, I think will convey in a very few words just exactly what was intended to be conveyed: "George Westinghouse, jr., from the National Electric Light association, in grateful recognition of numerous attentions and substantial favors extended by his various companies during the Pittsburgh convention, February 21, 22 and 23, 1888. Presented New York, August 31, 1888." I would like to recall to your recollection that Mr. Westinghouse's company, in a very delicate way, sent us quite a number of checks, which amounted in the aggregate to some $1,100 or $1,200, which were accompanied by the express wish that the subscription might contribute in some way to the publication of the valuable proceedings of this association. The best return we can make for the field given to us is to present the donor with the fruits which it produces, and we have here a copy of our transactions bound, in I hope an appropriate way, to convey at least our delicate sentiments to him. They are contained in a case that he may keep by him in such way as to remind him from time to time of his relations to this association, and how they were pleased to enjoy his hospitalities. Gentlemen, if Mr. Byllesby is not here we will then send it to Mr. Westinghouse, with the compliments of the association.

THE PRESIDENT: There being no other business before the association a motion to adjourn is in order.

On motion the convention adjourned.

NOTES.

The banqueting hall in which the convention met was about the proper size, but the usual complaint was made that there was difficulty in hearing some of the more modest speakers.

Harold P. Brown, electrical engineer, was in attendance, but did not take any leading part in the proceedings. The fallacies of his dog-killing experiments were very thoroughly exposed by Dr. Vander Weyde, who is well up in such matters.

The committee on the next place of meeting had a decidedly western tint, but general satisfaction was expressed privately upon the choice made. There are a large number who are always glad to visit Chicago or New York, either of which cities is well adapted for taking good care of a crowd of visitors.

It is safe to say that no commercial or scientific gathering in New York city has ever before been so fully reported by the metropolitan dailies, both morning and evening. For the first time, some really creditable portraits have been published, notably those in the *Graphic*, in which Edwards H. Goff is interested.

The association did a good stroke of work in providing for the establishment of a permanent office. It may be thought by many that New York is not the exact spot where it should be located, but that city is probably visited regularly by more members of the association than any other. If the work is well done, however, it does not make any material difference where it is done.

Of all the features of the Electric Light association convention, none was pleasanter than the experience of Thursday evening, when the delegates were invited by the Okonite company to witness "The Queen's Mate" at the Broadway theater, and to enjoy a supper afterwards at the Electric club. About 300 responded to the invitation. The performance was thoroughly appreciated and the special hits introduced caused much amusement. After the curtain fell the guests were invited to inspect the arrangements for the electric lighting on the stage. The party was welcomed at the electric club by C. A. M. Candee, in a very cordial and pleasing speech. He was followed by C. A. Cheever, Dr. Otto A. Moses, Dr. A. F. Mason, Pres. S. A. Duncan, Dr. A. V. Garratt, Frank Ridlon, A. J. DeCamp and others. Music and singing entertained the guests till a late hour.

EXHIBITS.

In connection with the convention of the National Electric Light Association, an exhibition was given illustrating many of the applications of electricity now coming into general use.

In Parlor 4 were the headquarters of *Modern Light and Heat*, and contiguous, a stand, with motor running, to demonstrate the merits of the Paillard Non-Magnetic watch. The balances and hair springs of this watch are made of an alloy of palladium, which combines non magnetic and non-corrosive qualities with the hardness and elasticity necessary for fine adjustments to temperature and isochronism.

Other exhibits were:

The Eddy Electrical Manufacturing company, Windsor, Conn., automatic electric motors and speed indicators.

Incandescent lamps on arc light circuits, Bernstein Manufacturing company, Boston, Mass.

Electric meter, Grove Electric company, 1406 Chestnut street, Philadelphia, for measuring lamp hours without connect on to main current.

The Electrical Review, 13 Park Row, New York.

Electro Dynamic company, Philadelphia, consumers' switches, ammeter knife switches, the combined Edco switch, house circuit knife switch, single blade knife switch, dynamo plug switch, ammeter plug switch, transfer switch, ammeter circuit switch, double pole dynamo plug switch, Edco lightning arrester, combined overload and over discharge switch, and rheostat.

Electrical Accumulator company, New York, Storage Batteries, etc.

WESTERN ELECTRICIAN, Chicago.

Giles Anti-Magnetic Shield & Watch Case company, 11½ Maiden Lane, New York, watches with anti magnetic shields.

Union Indurated Fiber company, New York, pipes for underground conduits, fiberite boxes, cells for secondary or primary batteries, etc. The pipes, being made from long fiber, molded into shape under heavy pressure, and by chemical treatment and vitrifying processes, are rendered waterproof and indestructible, and are adapted for underground work. The company's office is at 5 Barclay street.

C. McIntire & Co., 36 Crawford street, Newark, N. J., exhibit of wire joints showing the merits of the McIntire connector.

Eastern Electric Cable company, Boston, Mass., samples of "Clark" wire, 5-32 to 36 32.

Schenck Belt Holder & Shifter company, 93 Liberty street, New York, belt holder and shifter, devised to take the place of friction clutch pulleys; easily adjustable, independent of shaft, shiftable without shock or jar, or diminution of speed of pulley.

Electric Age, 5 Dey street, New York.

Electrical World, Potter Building, New York.

Sawyer Man Electric company, 510 W. Twenty-third street, New York, an exhibit comprising voltmeters, current indicators, dynamo main switches, circuit switches, cut-outs, sockets, finishing pieces, lamp guards, chandelier and bracket insulated joints, balance indicators, etc., and a display of 60 incandescent lights, ornamentally designed over the letters S–M, and an ornamental chandelier of 6 lights, current for which was supplied by a 75 light dynamo run by a 10 horse-power Baxter motor.

American Electrical Wire company, Providence, R. I., incandescent lamp cord, rubber-covered and other wires.

Okonite company, 13 Park Row, New York, Candee aerial wire and telephone, telegraph and electric light wires and cables for aerial, submarine, and underground uses.

Elektron Manufacturing company, 143 Nassau street, New York, dry batteries.

Phœnix Glass company, 729 Broadway, New York, glass ware.

F. E. Pettingell & Co., Boston, Mass., electric light, telephone and telegraph supplies.

Standard Underground Cable company, 16 Cortlandt street, New York, standard weather proof line wire, underwriters', office and annunciator wires, W. A. C. fire and waterproof wire, for use in damp places, and unaffected by heat, cold, alkalies or acids; and Waring electric light cables with standard lead and standard insulation for high or low tension currents.

Standard Paint company, 59 Maiden Lane, New York, P. & B. paints and compounds, waterproof and preservative, acid and alkali proof.

National Conduit Manufacturing company, 18 Cortlandt

street, New York, multiple conduits and wrought iron cement lined pipe for electrical subways.

E. P. Gleason & Co, 181 Mercer street, New York, glass ware.

By the courtesy of the Western Electric company, a long distance telephone was placed in room 16, expressly for the use of members of the association and visitors to the convention.

New York Insulated Wire company, Grimshaw's patent white core wires and cables.

Charles L. Ireson 97 High street, Boston, Mass., leather link belting.

Simplex Electrical company, 328 Washington street, Boston, Mass., "Simplex" T. Z. R. insulated wires, and "Simplex" insulating tape

Thomson Electrical Welding company, two boards containing samples of electric welds, iron pipe, solid copper rod, brass tube, cast iron, chisel broken and welded, steel shaft with two welds, machine steel in five pieces, wrought iron in five pieces, brass rod, steel iron, cast tool steel, lead pipe chains, and other metals and alloys, among which may be specially mentioned a rod in which zinc, copper, brass and German silver were welded together.

Campbell Electrical Supply company, 95 Milk street, Boston, Mass, Vulcan insulated wire.

Government Waterproof Paint company, 52 Fulton street, New York.

Sprague Motor company, 239 Broadway, New York, one horse power Sprague Motor, showing the new self-oiling bearings, with spiral oil way.

Baxter Motor company, Potter Building, New York, motors.

C. S. Schieren & Company, 76 Cliff street, New York, electric leather belting, devised especially for smooth running, held together with patent wire screw fastenings.

Waltham Non-Magnetic Watches.

James W. Queen & Co,. 924 Chestnut street, Philadelphia, electrical instruments, comprising ammeters, volt meters, quadrant and absolute electrometers, galvanometers, rheostats, chloride of silver batteries, tachometers, speed counters, rheometers, Wheatstone-Kirchoff bridges, resistance coils, etc.

Hill Clutch Works, 18 Cortlandt street, New York, pul'eys and couplings.

A. B. Laurence (Underwood Man'fg company), 82 John street, New York, patent cotton-leather belting.

Callender Insulating & Waterproofing company, 45 Broadway, New York, insulated wires for house work for electric lighting, lead covered wires for house lighting, flexible cords and cables, insulated wires for underground work, Trinidad line and pressure wires, large underground cable feeders, three-conductor underground service cable, insulated wires for telephone, telegraph, district messenger and other purposes, submarine cables, etc.

J H Bunnell & Co., 106 Liberty street, New York, agents for the Eickemeyer dynamos and electric motors, were represented, as were also Roberts Brevoort Electric company, limited, makers of new primary batteries for house lighting and power, 206 Broadway, New York, the National Carbon company of Cleveland, O, which distributed an interesting directory of electric arc light plants in North America, the O'Keenen Electric Manufacturing company, 45 Broadway, New York; Stilwell & Bierce Manufacturing company, Dayton, O, makers of the Victor turbine; New England Butt company, Providence, R. I., and the American Tool & Machine company, 84 Kingston street, Boston, Mass., makers of belt controllers.

E. S. Greeley & Co., 5 Dey street, New York, dry batteries, Wheatstone bridges, telephone, telegraph and electric light supplies, model of the Statue of Liberty, from the torch of which shines out a tiny incandescent light.

A. Schoverling, 111 Chambers street, New York, Dr. Gassner's dry battery.

Hurlbut Flexible Conduit company, Room 81, 52 Broadway, New York, Hurlbut's patent flexible joint for electrical conduits, sewer pipes and vitrified fire clay conduit.

Law Telephone company, 112 Liberty street, New York, Law prism battery for telephones, gas lighting, burglar alarms, bell annunciators, and for medical and general purposes.

Locke Brothers, Salem, Mass., Locke's damper regulator.

Eugene Phillips' Clam Bake.

In response to the hospitable invitation of Eugene Phillips, of the American Electrical works, Providence, a large number of the electrical fraternity gathered at Silver Spring on Saturday, the 1st inst., to enjoy a clambake of the good old-fashioned sort. The New York contingent was large, and included the members of the National Electric Light association, whose convention closed the day before. The party left New Yock on Friday evening, on the steamer Catskill, and it was soon quite evident that, like John Gilpin of old, on "pleasure they were bent." After supper Frank Ridlon was unanimously chosen master of ceremonies, and after a grotesque but effective march to the inspiring strains of the band, recitations and songs were given, and a very enjoyable evening was passed. If the steamer had progressed as swimmingly as her passengers, she would have made Providence by 8 o'clock Saturday morning, but the captain decided not to leave New London until nearly that time, and consequently Providence was not reached until 2:30 in the afternoon. The delay, however, did not affect the spirits of the electricians who had come to enjoy themselves. They were cordially welcomed at Providence by Mr. Phillips. A photograph of the guests was taken, after which they proceeded to the business of the day.

Gov. Taft opened the proceedings by a speech, in which he stated that this was the tenth time that Mr. Phillips had welcomed his friends to the clambake, and he boasted of the peculiar excellence of the Rhode Island clam. Three cheers were given for Mr. Phillips, and also three for Mrs. Phillips.

Toastmaster Col. Ransom was then introduced, and letters were read regretting the absence of H. Howard, N. S. Possons, Cleveland; G. H. Phillips, New York; H. Bull, jr., D. H. Fitch, W. J. Johnston, New York; T. C. Martin, New York; J. Wetzler, New York.

H. C. Davis, who was stated to have been absent on a diamond hunting expedition in Africa and New Jersey, amidst much laughter presented to Mr. Phillips a pin of dazzling brilliance, the head of which weighed a pound, more or less. A jewel of the same goodly proportions was presented to W. H. Sawyer.

Ex-Gov. Howard, in a brief speech, said that to the nomenclature of electricity, the volts, amperes, microfarads, etc., with which they were all familiar, there should be added another word expressive of all that is cordial, kindly, and hospitable—the word "Phillips." He said that clam and men went together; wherever there were good clam good men were found, General Barney gave an explanation of the detention of the "Catskill," which put the blame on the passengers and not the boat. H. C. Davis, on behalf of the New York delegation, presented Mrs. Phillips a handsome cut glass vase, and to Mrs. Sawyer an ice cream, for which Mr. Phillips and Mr. Sawyer duly returned thanks. Their replies were supplemented by a few remarks by Ex-Gov. Taft.

The following gentlemen followed with speeches: Messrs. Pettison, Goodyear, W. B. Gilbert, D. H. Alexander, C. G. Perkins, C. E. Stump, W. A. Kreidler, T. D. Lockwood, after which one of the most enjoyable clam bakes was brought to a close. The New York electricians subsequently left for Newport to spend the Sunday before returning to New York.

The following were present at the clambake: John Tregoing, Lynn, Mass.; F. A. Gilbert, Boston; Geo. B. Neal, Boston; H. J. Miller, Boston; Herman Bergholtz, Lynn, Mass.; G. B. Baker, New Haven; Chas. Burgher, Boston; Chas. S. Bly, Boston; E. P. Jacobs, Haverhill; A. D. Wheeler, Boston; Chas. Sylvester, Fall River, Mass.; Chas. J. Slidden, Lowell, Mass.; G. M Carhart, Providence, R. I.; A. L. Russell, Boston, Mass.; N. W. Lillie, Boston, Mass.; R. S. Faber, New Bedford; Henry S. Thombury, Montreal; M. M. Ogden, Pittsburg; T. M. McCoubray, New York; F. H. Leonard, jr., Syracuse; Benjamin Rhomes, Niagara Falls, N. Y.; A. P. Seymour, Syracuse; C. E. Stump, New York; Alfred Shedloch, New York; John D. Shedloch, New York; Wm. F. Cullen, New York; Carl Hering, Philadelphia; J. C. Ackerman, New York; J. D. Richardson, jr., Newport; H. F. Cranston, Providence; A. H. Barney, New York; Alex. McLellan, Providence; H. F. Kellogg, Newport; Geo. S. Bauman, New Haven; L. W. Clarke, Providence; F. E. Morse, New York; P. H. Alexander, New York; Alex. P. Wright, Springfield, Mass., P. Fahig, Boston; Thos. D. Lockwood, Boston; F. G. Chafee, Providence; J. W. Duxbury, Boston; W. J. Denver, Boston; H. P. Slater, Leadville, Col.; Jas. H. Cary, Woonsocket; Frank Dillon, Boston; T. C. Doolittle, Bridgeport.

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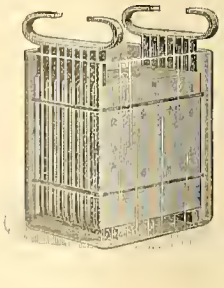

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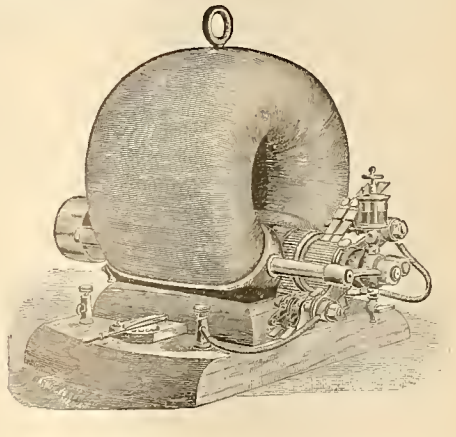

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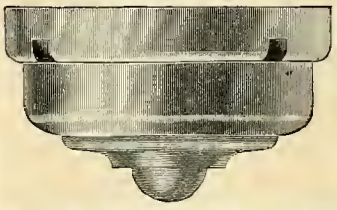
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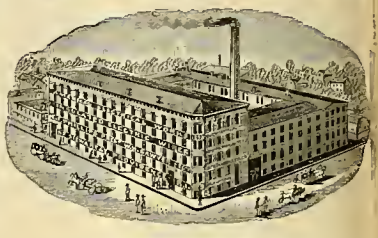
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PATENT AND TRADEMARK CASES.

Sealed Proposals
—FOR—
Lighting the City with Electricity.

MAYOR'S OFFICE,
NATCHEZ, MISS., Aug. 27th, 1888.

Notice is hereby given that sealed proposals will be received at the office of the City Clerk until **12 o'clock M., November 1st, 1888**, for lighting the streets, alleys, commons or parks of the city, with electricity, in accordance with plan and specifications to be placed in the City Clerk's office, for the period of five years, that is to say, that portion of the city now lighted with gas, from the 1st day of March, A. D., 1889, and that part lighted by coal oil lamps, from the 1st day of June, A. D., 1889.

Each bidder is required to file with his bid a detailed statement of the number and location of the plants then in operation, of the particular system which he proposes to establish in Natchez if successful in bidding, and to specify as to each plant so in operation whether it is the one originally established in such locality or has been substituted for some other previously in use, and, if a substitute, then for what system.

The successful bidder will be required to enter into good and sufficient bond, of such penalty as the Mayor and Aldermen shall hereafter fix, conditioned that he will erect and have ready for use the electric plant, and begin the lighting of the city therewith, on the dates hereinbefore stated.

The Mayor and Aldermen reserve the right to reject any or all bids.

W. H. MALLERY,
Mayor of City of Natchez.

I. W. COLBURN & CO.
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Machines for Arc and Incandescent Electric Lighting, Electro-Plating and Experimental Use.
Send for large Illustrated Catalogue, also Handbook of Ready Reference, vest-pocket edition.

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Insulated Wires, Flexible Cords and Cables for Telephone, Telegraph
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A WONDERFUL INVENTION
DR. GASSNER'S DRY BATTERY,
THE BEST
OPEN-CIRCUIT BATTERY
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E. M. F., Volts. 1.44.
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Satisfaction Guaranteed,
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Complete Power Plants Furnished and Erected.
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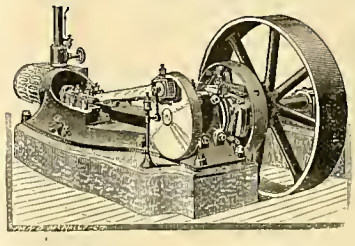

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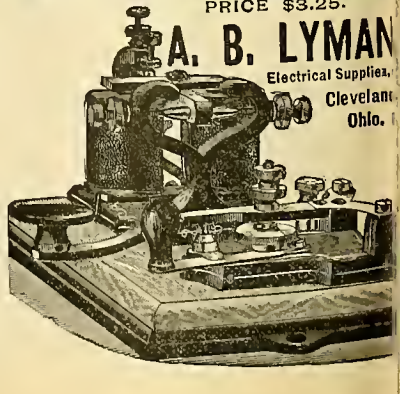

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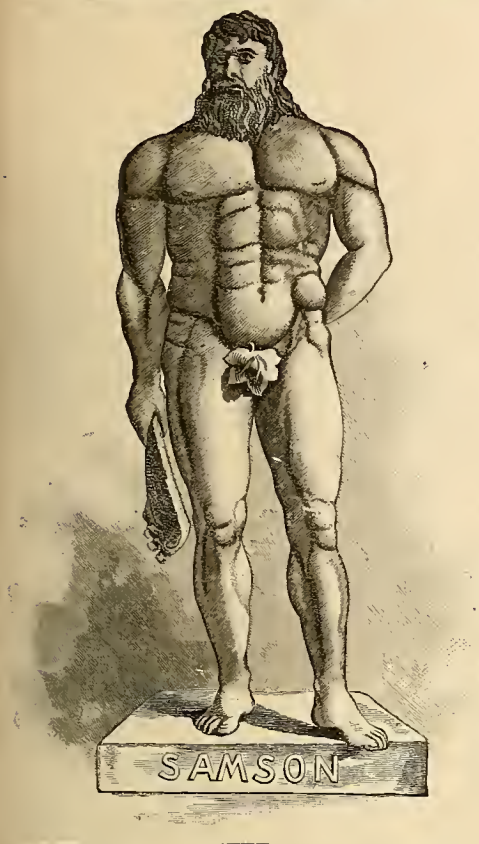
THE "SAMSON" BATTERY



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Report on the performance of three cells examined for their E. M. F., Internal Resistance and Current Strength by Prof. A. E. Dolbear.

NAME OF CELL.	E. M. F.	INT. RES.	CURRENT AT OUTSET.	C. AFTER 30 MINUTES.
Genuine Gonda "Disque" Lec.	1.46 volts.	1.25 ohms	.61 ampere.	.26 ampere
Sameon No 1.	1.44 "	.14 "	1.16 "	.52 "
Samson No. 2.	1.47 "	.11 "	1.11 "	.70 "

"The cells were all put in circuit with a resistance of 1.1 ohms, and kept on that circuit for the above measure of current. The very small internal resistance of the two "Samsons" enables them to give a current very nearly twice as great at the beginning as the other, while the "Samson" No. 2 gave a stronger current (.70 ampere) after half an hour short circuit, than the Disque Leclanché cell at the beginning."

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"It appears therefore that the "Samson" cells are much more energetic than the one they were compared with; so much so, that one of them is about as good as two of the latter kind for such service as the production of strong current or strong magnetic effects."

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It recuperates quickly after having been repeatedly overtaxed and short-circuited, and will do more effective work after such repeated short-circuiting than any other sal ammoniac cell.

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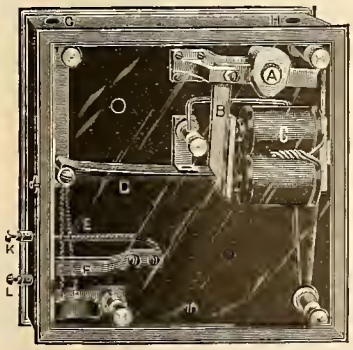

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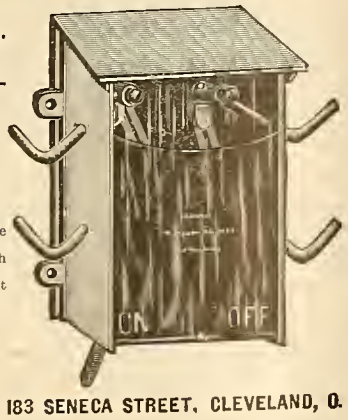
Quick Make and Break Uncontrolled by the Handle.



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*Lewiston Electric Light Co.....Lewiston, Me.
*New Bedford Electric Light Co.....New Bedford, Mass.
*Fall River Electric Light Co.....Fall River, Mass.
Syracuse Electric Light Co.....Syracuse, N. Y.
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*Brockton Electric Light Co.....Brockton, Mass.
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Gloucester Electric Light Co.....Gloucester, Mass.
Bar Harbor Electric Light Co.....Bar Harbor, Me.
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Oak Island Electric Light Co.....Oak Island, Mass
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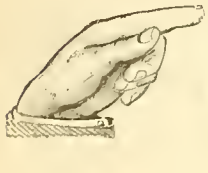

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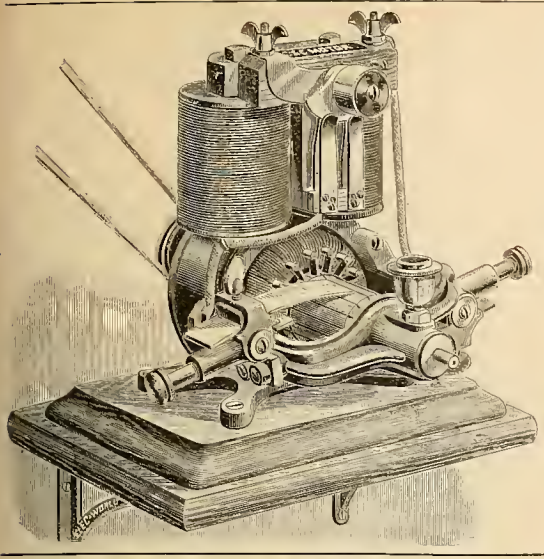

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CHAS. J. VAN DEPOELE,
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Sure protection from all Electrical and Magnetic disturbances. Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

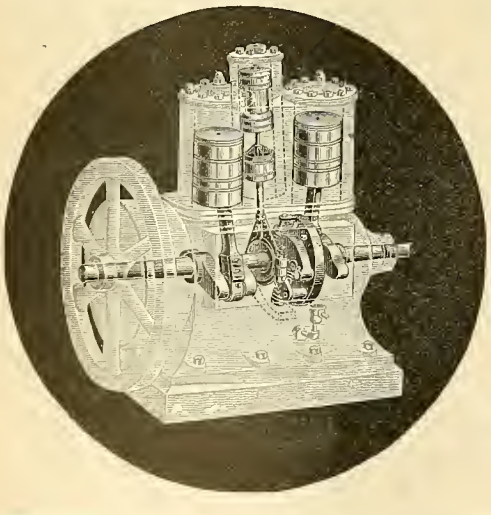
The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
Prof. Phs. Dept., Cornell University.

The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and inoperative on account of their susceptibility to the all-pervading magnetic influence.

AMERICAN WATCH CO.,
Waltham, Mass.

GILES BROS. & CO. 103 State Street, CHICAGO.



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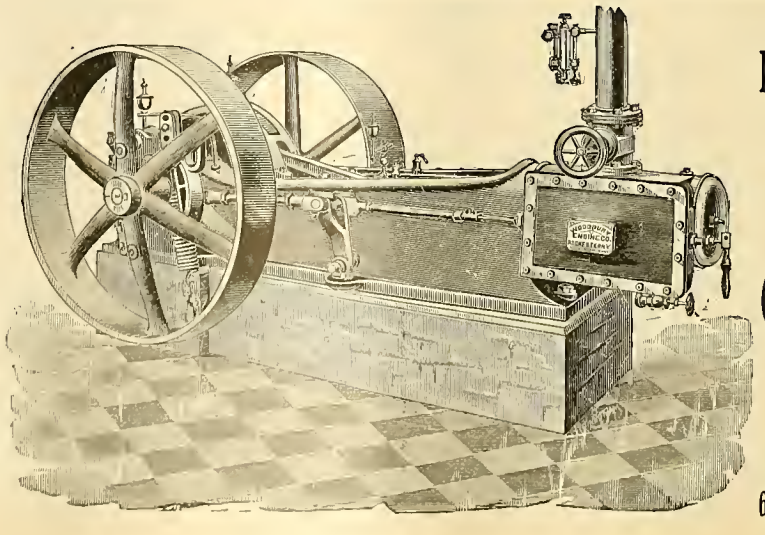

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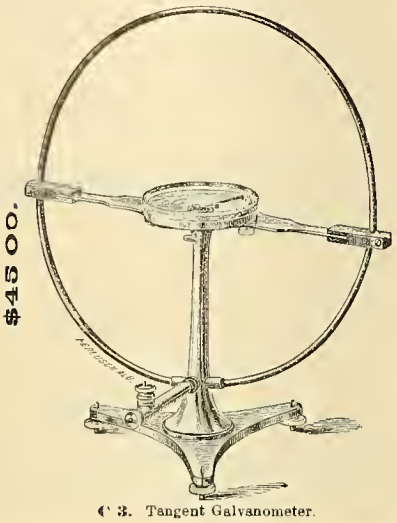

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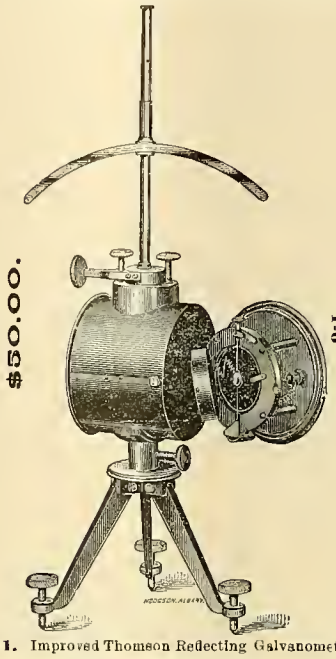

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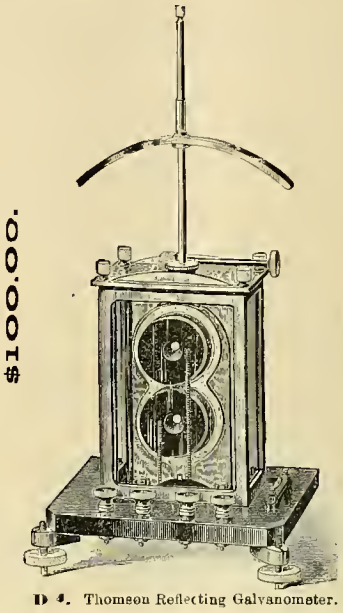

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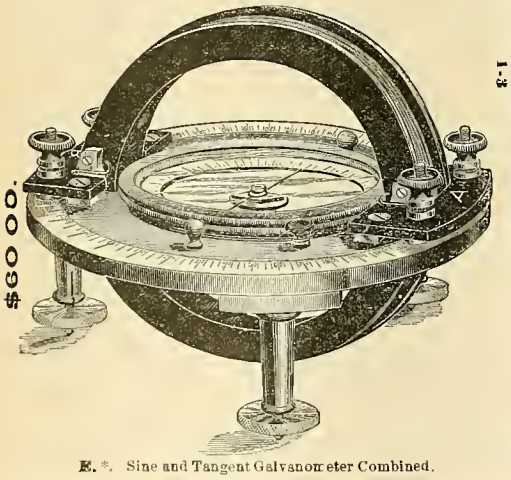

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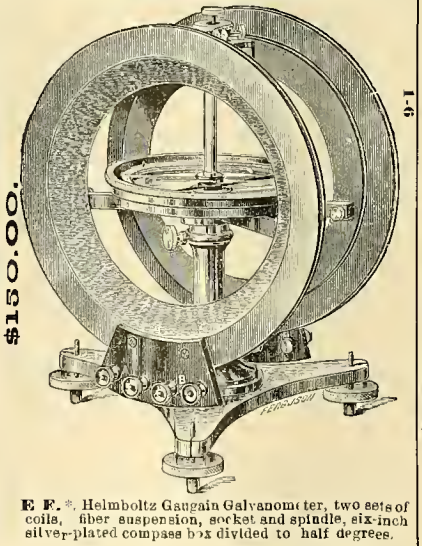

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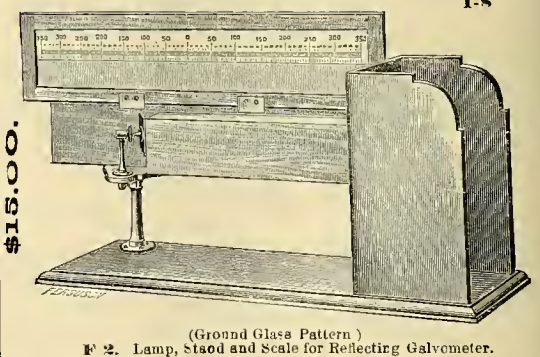

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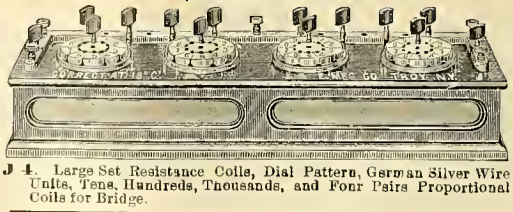

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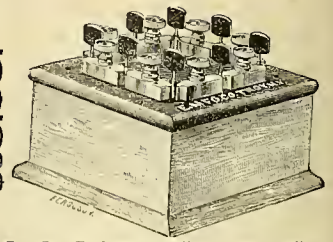

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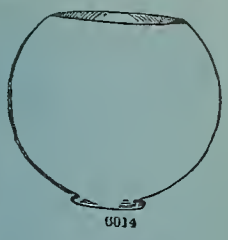
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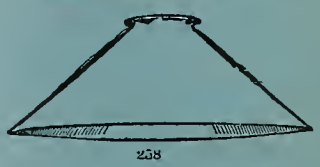
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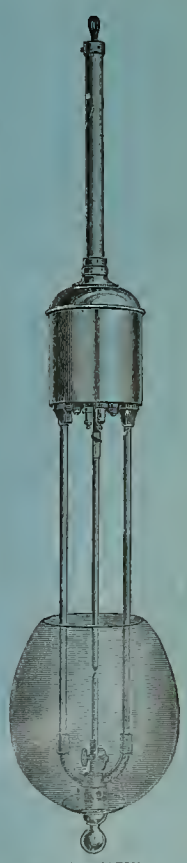
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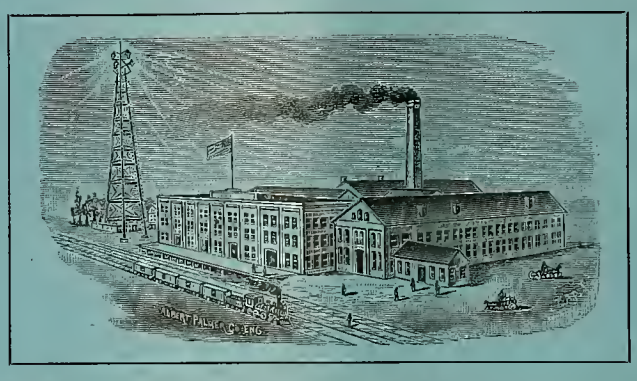

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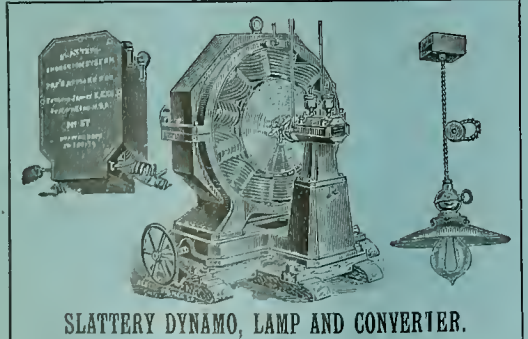

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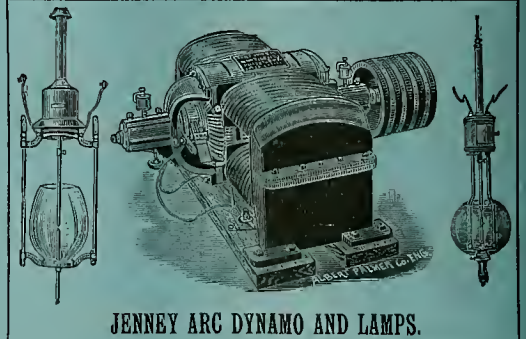

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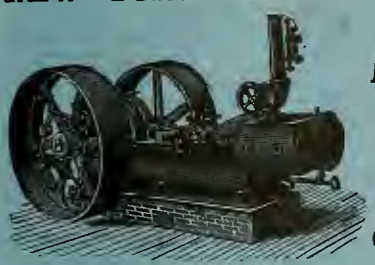

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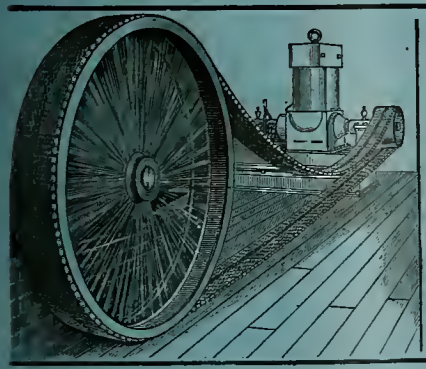

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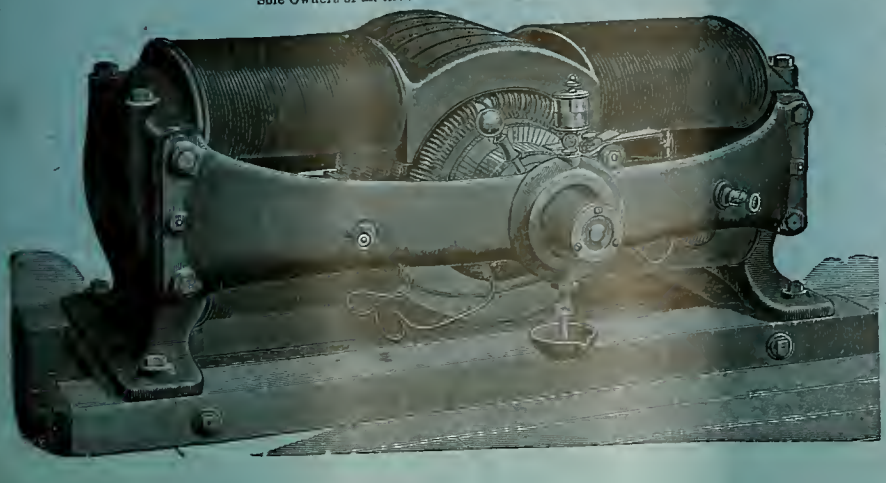

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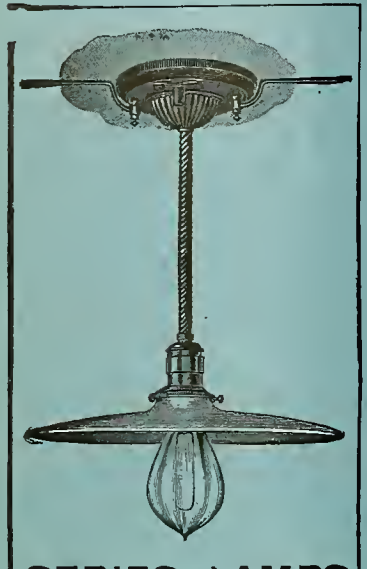

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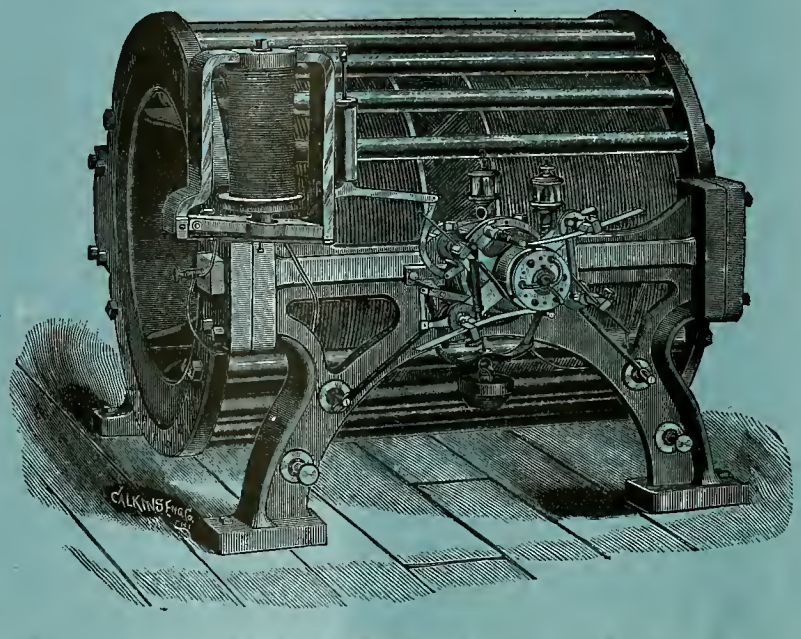

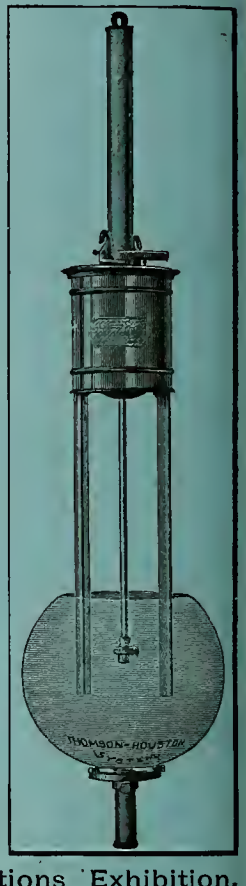

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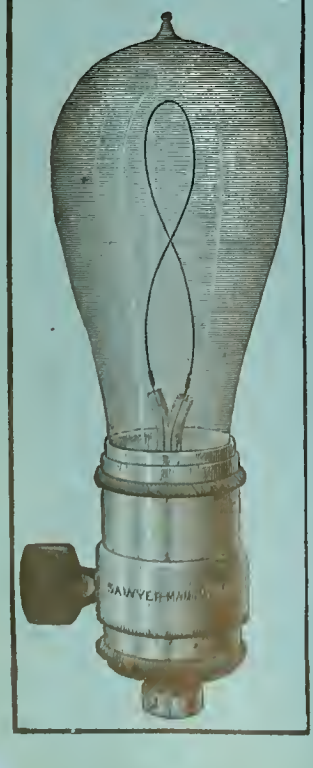

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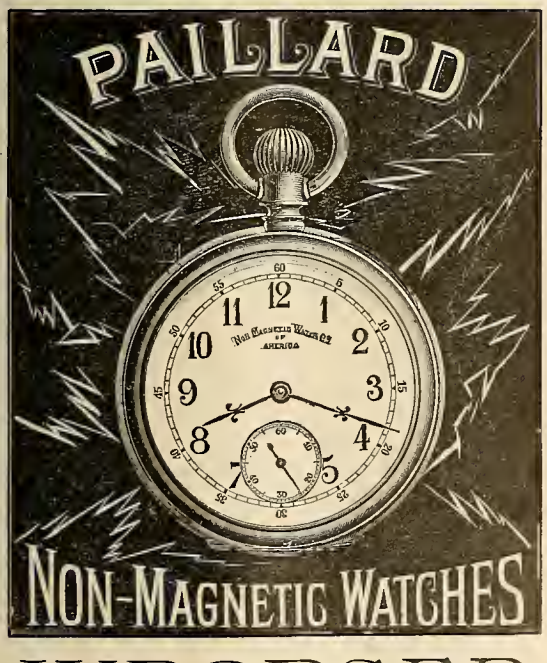

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—BY—

Thomas A. Edison, Elihu Thomson, N. S. Possons, Edwin J. Houston,

AND SCORES OF LEADING ELECTRICIANS.

FOR SALE BY ALL JEWELERS.

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177-179 Broadway, N. Y.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

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EDISON PLANT WAS REJECTED AND PUT OUT,

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U. S. 610 Lamps, 53 H. P., equals $11\frac{50}{100}$ per H. P.
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ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

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THE DAFT ELECTRIC CO.,

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The only Company using Safe Currents in the operation of Street Railways.

Speed,
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The Daft Motors for Power Distribution are unexcelled.

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ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

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The Parker-Russell Mining & Mfg. Co.,

Electric Light Carbons,

Adapted to all Systems.

CITY OFFICE,
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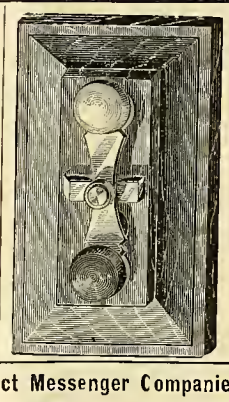

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Electrical Works,

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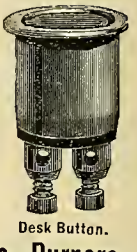

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Keys for Operating Automatic Burners.

Wood Base Outside Contact. Wood Base Inside Contact.
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The Attention of Electric Light, Telephone and District Messenger Companies is Especially Called to Our

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THE UNIVERSAL CONDEMNATION of the so-called Underwriters' Wire and the demand for something better, has induced us to offer our new TRINIDAD LINE WIRE as a substitute for its use, and at a very little higher price. This wire is served with two coatings of our Bituminized Tape and braided over all. A serving of Trinidad Compound is put on between each tape and braid. The outside finish is neat, clean and strong. It will not liquefy or become sticky with heat, nor brittle with cold. The covering is tough and tenacious; will stand rough usage and a rubbing contact without abrasion. We claim that our TRINIDAD LINE WIRE is the cheapest well insulated and most serviceable wire offered for all pole work, especially for high tension currents.

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ILLUMINATING COMPANIES proposing an extension of their Incandescent Plants are invited to correspond with the undersigned before commencing construction. With our recent improvements and reductions in price, the cost of placing large incandescent Cables underground in a solid and substantial manner is brought within actual business limits.

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THE CALLENDER COMPANY have, during the last two years laid many miles of large cables underground, all of which are in actual work. The difference in cost between an overhead and underground system for Incandescent work is now no greater than is warranted by the better service insured by an underground system. The Callender Company's Underground Incandescent Cables and System have been in actual operation for some two years in twelve cities, and are indorsed by all the parent light companies.

Manufacturers also of Insulated Wire for Electric Lighting for House Purposes, and in all places where good Insulation is Required.

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For Light and Power Purposes.

Estimates for furnishing plants can be had on application to

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For STATIONARY or RAILWAY Work, for MINING or ENGINEERING Operations the SPRAGUE MOTOR is UNEXCELLED.

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STEUBENVILLE, OHIO.
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AKRON, OHIO.
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February 1st not a Road in Commercial Operation, To-day Consult the Above Record.

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is tanned on the surfaces only; the
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Send for Our Valuable Book for Engineers and Belt Users. Free.
Agents in all Cities. Send for Trial Belt.

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CONSOLIDATED ELECTRIC LIGHT COMPANY,

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

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Insulated Wires, Cables and Flexible Cords.

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Rubber covered wires for use overhead and underground, and for indoor wiring. Equal to any in the world for insulation and durability.

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Gutta Percha covered wires and cables for use under water and in damp places.

MARKS' COMPOUND

Battery wires insulated with Marks' Compound give better service than any other wires in the market.

BALATA.

We are sole manufacturers of this celebrated insulation which contains no sulphur or other ingredient that will ever corrode copper. It is used principally for flexible cords.

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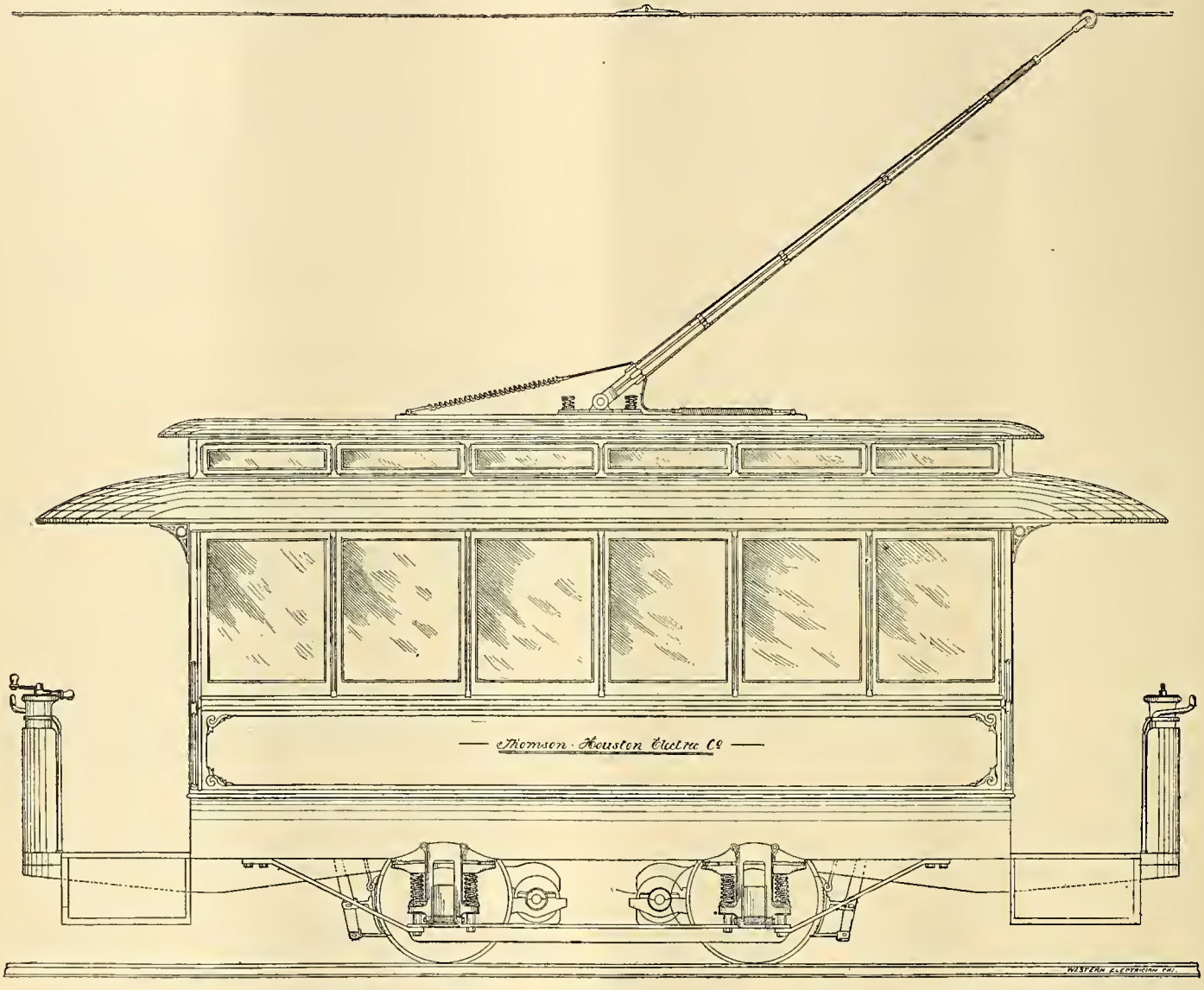
The Thomson-Houston Electric Railway System.

THE THOMSON-HOUSTON ELECTRIC COMPANY HAS RECENTLY PURCHASED ALL THE VAN DEPOELE ELECTRIC RAILWAY PATENTS.



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The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

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No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Van Depoele patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

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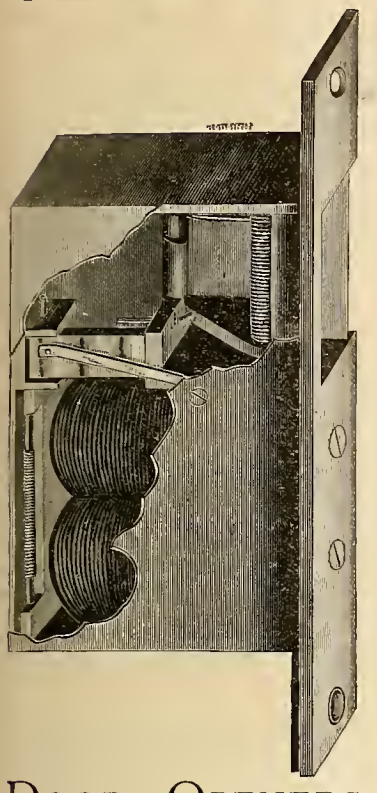

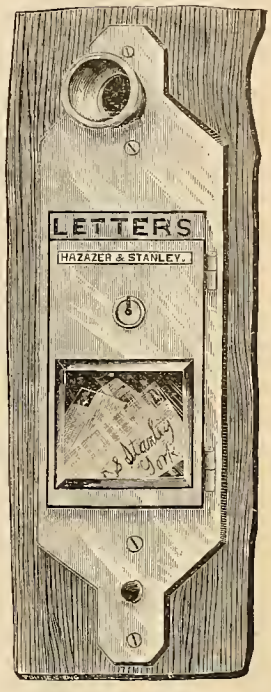

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AT PRICES THAT CAN'T BE BEAT.

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GELATINE

TRADE MARK

BATTERY.

The Automatic Medical Battery

The Cox Tangent Galvanometer.

For Descriptive Circular, further particulars, etc., address,

READ THIS TESTIMONIAL.

NEW HAVEN, CONN., July 12, 1888.

THE H. B. COX ELECTRIC CO.,

NEW HAVEN, CONN.

DEAR SIRS:—In reply to your inquiry, I beg to say that I have used the Cox Gelatine Batteries for telephone work in the police signal boxes of the Brewer & Smith Visual Signal System, also in the Gamewell Police Telephone System, and in the telephone service of the Fire Department of this city since October, 1886, and they have given perfect satisfaction.

I have used them in the signal boxes without covering or protection of any kind from either heat or cold, and they have required NO ATTENTION or RENEWAL of PARTS WHATEVER, those longest in use doing their work as well to-day as those more recently put in use.

I consider them THE VERY BEST BATTERIES in existence for this kind of work.

Yours, etc.,

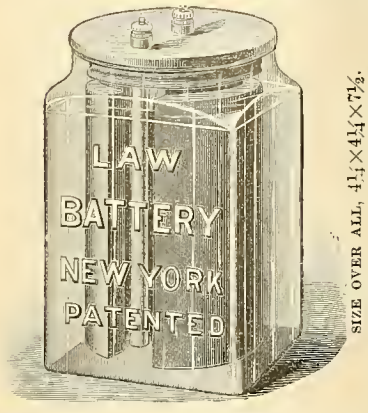
W. C. SMITH,

Supt. Fire and Police Telegraph.

THE H. B. COX ELECTRIC CO.,

Box 1054, NEW HAVEN, CONN.

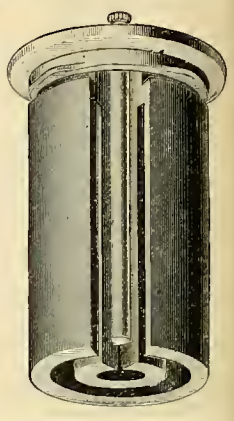
THE LAW BATTERY.



SIZE OVER ALL, 4½×4½×7⅛.

FOR ALL CLASSES OF OPEN CIRCUIT WORK.

In the latest form the negative element is a ***Double Cylinder, one within the other,*** having more surface and quantity than any other negative element in the market. Its efficiency and durability surpass all its rivals, and ***it is guaranteed for ten years.*** As now made both elements are secured wholly beneath the cover, instead of passing through the cover, as heretofore. The cover is of blue glass and locks tight to the jar, absolutely preventing evaporation of water and creeping of salts. Both binding posts are permanently attached to cover, and thoroughly protected against corrosion.



THESE ARE DECIDED IMPROVEMENTS.

Do not be so foolish as to buy a Prism, Porous Cup, or other perishable negative element battery, when one can be had which is ***PRACTICALLY EVERLASTING.*** And do not waste money by experimenting with any of the numerous new and untried batteries which are constantly coming and going, but buy the "Law," which ***has stood the test of eight years.***

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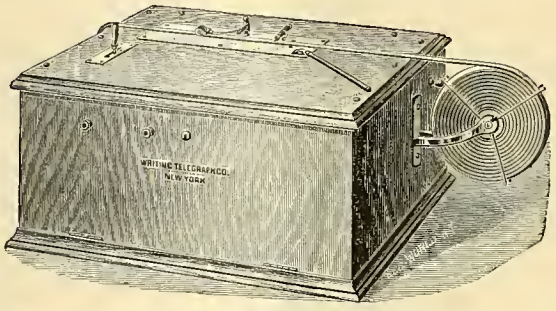
This Company owns the Letters Patent which thoroughly control the transmission of written messages by telegraph in the only known practical way, and are prepared to establish Central Office Exchanges as a means of communication between subscribers in cities and surrounding towns.

Communications are written with pen and ink in the handwriting of the person writing the message.

For particulars address



The pen in the office of the subscriber receiving a message makes a fac-simile of every letter as fast as it is made with the pen in the office of the person writing it.

All instruments are under the control of the Central Office, and messages are recorded on the instrument of a subscriber, whether he is present or absent.

All communications are secret, and the written record is of great value in commercial use.

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By F. B. BADT.

100 pages; 70 illustrations; flexible cloth binding; size of type page, 6x3 inches.

Designed for Dynamo Tenders and Linemen, Stationery and Marine Engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

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ADDRESS

ELECTRICIAN PUBLISHING CO., Publishers,

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WESTINGHOUSE ELECTRIC COMPANY,

PITTSBURGH, PA.,

Manufacturers under Patents controlling the Sale and Use

OF

ALTERNATING CURRENT ELECTRIC LIGHTING APPARATUS.

The installment of over 100 Central Station Plants has demonstrated the Alternating Transformer System to be superior to all others, for distributing current from a Central Station over small or large areas for lighting and power purposes.

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This system is made more profitable than any other by the use of the meter now supplied by this company.

It measures the whole current.

It is strictly a positive mechanical movement.

It registers directly in lamp hours.

It reads from dials like a gas meter.

It consumes no appreciable energy.

It is not affected by temperature or other local conditions.

It is practical, and it is cheap.

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This company has demonstrated that motors run by the alternating current are as efficient as the best direct current motors, and can be run without commutators or brushes, being started, stopped and reversed without breaking a connection.

All parties desiring to secure the most perfect system of electric distribution for light and power are invited to inspect the apparatus at the works of the company at Pittsburgh, Pa., where it will be demonstrated that the Alternating System possesses such advantages over the direct system in regard to efficiency, distribution, safety, life of lamps, and the use of meters and motors, that no purchaser can afford, at any price, to take the direct current apparatus.

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ELECTRIC ARC LIGHTING APPARATUS.

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Testing Apparatus. Telegraph Apparatus. Batteries.

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District Telegraph, Police and Fire Alarm Apparatus.

The Best of Everything at Bottom Prices

Catalogues Furnished on Application.

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, SEPTEMBER 15, 1888. No. 11.

TENTH ANNUAL CONVENTION

Of the National Telephone Exchange Association.

The tenth annual meeting of the National Telephone Exchange association was held at the Hotel Brunswick, New York city, Tuesday and Wednesday, September 4 and 5, 1888. Following is a list of the members and guests present, and a report of the proceedings:

MEMBERS AND GUESTS.

Henry Metzger.....Pittsburgh, Pa.
C. H. Barney.....New York.
E. G. Main.....Brooklyn.
C. G Glidden.....Lowell, Mass.
Thos. B. Doolittle.....Boston, Mass.
J. J. Carty.....New York.
H. D. Mayer.....New York.
Geo. L. Beetle.....New York
A. L. Salt.....New York.
F. W. Harrington.....New York.
F. J. Boynton.....New York.
F. A. Pickernell.....New York.
W. A Hovey.....Boston.
G. F. Durant.....St. Louis.
J. B. Speed.....Louisville.
Jas. Clark.....Louisville
H. W. Gifford.....Louisville.
A. O. Morgan.....Boston.
Thos. D. Lockwood.....Boston.
Chas. W. Price.....New York.
J. M. Brown.....Washington.
T. B. Doolittle.....Bridgeport, Conn.
G. B. Field.....Denver, Col.
Flemon Drake.....Omaha.
R. M. Bailey.....Williamsport.
C. E. Fairburn.....Chicago.
A. Bryan.....Washington, D. C.
Chas. W McDaniel.....Kansas City.
C. J. French.....Boston.
W. N. Easterbrook.....Elmira, N. Y.
J. H. Fairburn.....Boston.
W. H. Cull.....Albany, N Y.
C. A. Nicholson.....Utica, N Y.
F. G. Wood.....Utica, N. Y.
D D. Sargent.....Brooklyn.
Samuel Ivers.....New Bedford, Mass.
A. C. White.....Providence, R I.
F. E. Degenhardt.....Chicago, Ill.
F. A Forbes.....Detroit.
P. A Seeley.....New York.
Nath. W. Lillie.....Boston.
Geo T. Mansen.....New York.
W. J. Dunn.....Boston.
Joel C. Clark.....Morristown, N. J.
Henry C. Davis.....New York.
Ralph W. Pope.....New York.
Geo H. Guy.....New York.
P. C. Ackerman.....New York.
W H. Eckert.....New York.
T. C. Martin.....New York.
Frank B. Knight.....Texas.
Theo. Albree.....Omaha
W. Bamfield.....Easton, Penn.
J. W. Godfrey.....New York.
Francis J. Hovey.....New York.
Henry D. Stanley.....Bridgeport, Conn.
C. E. Stump.....*The Electrical World.*
Geo. W. Arnold, jr.....New York *Times.*
J. M. Jackson.....Chicago
Ed. J. Hall, jr.....New York.
David B. Parker.....New York.
W. A. Vail.....New York.
T. Atwater Barnes.....New Haven, Conn.
J. E McConnell.....New Haven, Conn
H. Reilly.....Brooklyn.
Henry S. Thornbury.....Montreal.
C. F. Sise.....Montreal.
A. S. Hibbard.....New York.
M. M. Hayden.....New York.
A. D. Bulloch.....Cincinnati
G. P. McQuade.....New York.
Leonard F. Beckwith.....New York.
A. A. Knudson.....St. John, N. B.
T T. Smythe.....New York.
E. S. Perot.....New York.
Geo. Albree.....Boston.
J. R. Dee.....Houghton.
E. V. Cherry.....Cincinnati
A. D. Bullock.....Cincinnati.
P. H. Alexander.....Boston.
Ed. J. Hall.....Buffalo.
B. Abdank-Abakanowicz.....Paris.
C. E. McCluer.....Richmond.
John D. Esterlin.....Charleston.
W. J. Cole.....Atlanta.
Chas. Dutton.....New York.
D. J. Cassin.....New York.
H L. Storke.....New York.
F A. Magee.....New York.
Jos. Weltzer.....New York.
C. O. Baker, jr.....Newark, N. J.
J. B. Taltavall.....New York.
W. A. Childs.....New York.
Jean A. Wetmore.....New York
Schuyler S. Wheeler.....New York.
G. L. Wiley.....New York.
C F. Cutler.....Brooklyn.
E. B. Baker.....New Haven, Conn.
A. B. Kline.....Albany, N. Y.
J. F. Kelley.....New York.
J. M Brush.....Philadelphia.
W. T. Westbrook.....Philadelphia.
Chas. F. Cutler.....New York.
R. F. Ross, jr.....Boston
H. Green.....New York.
Fred A. Mason.....Bridgeport, Conn.
C. B. Truex.....New York.
J. R. Crandall.....Washington, D. C.
H. W. Upperman.....Washington, D. C.
I. Elliot Smith.....New York.
Ronald Crawford.....New York.
W. A. Kreidler.....WESTERN ELECTRICIAN.

Tuesday's Proceedings.

The association was called to order at 11 A. M., the president, Henry Metzger, of Pittsburgh, in the chair.

The secretary, C. H. Barney of New York, called the roll, and at its close announced that there were present delegates representing twenty-six active companies forming active membership, two representing the corporations forming the associate membership, and five honorary members.

Henry C. Davis, president of the Electric club of New York, was introduced, and on behalf of the Electric club and of the citizens of New York, extended a cordial welcome to the association.

The National Conduit Manufacturing company, J. P. McQuade, secretary, made application for associate membership. On recommendation of the executive committee the application was granted.

On motion, the executive committee was directed to investigate and report on the cases of the Cumberland Telephone company, the Great Southern Telephone company, and the East Tennessee Telephone company, who had tendered their resignations; the case of the Clark Insulated Wire company, which now has no existence, and any other names on the list of active or honorary or associate members that might be in question.

TREASURER'S REPORT.

TREASURER H. L. STORKE: I have to report that the finances of the National Telephone Exchange association are in a sound condition. The association enters upon the next year of its existence with a surplus of $21.85. The surplus of $37.23 of a year ago has been slightly reduced. The receipts of the year have been $1,937.69 and the disbursements $1,953.17; that is, during the year the actual expenses have slightly exceeded the revenue.

The report was referred to the executive committee.

REPORT OF EXECUTIVE COMMITTEE.

Minutes of the meeting of the executive committee, held September 4, 1888 were read by the secretary.

The report and its recommendations on motion were adopted.

OFFICERS ELECTED.

The election of officers resulted in a choice of the following:

President—Henry Metzger; Vice-President—W. D. Sargent; Treasurer—H. L. Storke; Members of Advisory Committee—Morris F. Tyler;—Members of Executive Committee—Samuel M. Bryan of Washington, W. J. Denver of Boston, George M. Stone of Cincinnati, C. F. Cutler of Brooklyn.

In accepting his re-election to the office of president, Mr. Metzger said: According to the constitution, the object of the association is to collect, preserve and protect the various matters of importance to telephone interests, and how well this association has succeeded in executing this trust can be answered by referring to the telephone statistics of the day. Every city, town and village in the country, from the Atlantic to the Pacific, from the borders of Canada to the Gulf of Mexico, give visible evidence of the work you have performed in developing the telephone business. But I do not intend to take you back and recall the history of the past. It is sufficient for me to ask you to go to that period of time, one year ago, when we were assembled in the city of Pittsburgh. It was a time pregnant with uncertainties and doubts as to what the status of the telephone companies would be for the coming, that is to say, the past year, and probably for all time. It is true that every Circuit court of the United States, wherever the American Bell Telephone company brought suit, had granted preliminary and final injunctions against infringers, whether defended by government aid or by private wealth and influence. Yet there still remained a doubt as to the final outcome The glorious uncertainties of the law were too well known to all of us, and although our faith in the righteousness of our cause was firmly grounded, yet some unexpected resistance might develop that would weaken our faith in the wisdom, justice and honesty of men. After a long, bitter and expensive struggle the day of judgment came. It was delivered by that honest and eminent jurist, Morrison R. Waite, the late chief-justice of the Supreme court, whose memory, I think, the telephonic fraternity should revere, and over whose grave we can all shed the tear of regret at his untimely death. But before yielding up his life he placed the seal of judicial authority on the scroll of fame that bore the name of Alexander Graham Bell as the inventor of the speaking telephone (applause); and in this connection I cannot forbear saying to the association that we are much indebted to those two eminent attorneys, J. J. Storrow and E. N. Dickerson for their masterly knowledge of the science of telephony and their keen analysis of the evidence as produced in the various causes which they argued. Since that time we have had a period of repose; a feeling of security has pervaded the minds of our stockholders in regard to the safety and permanency of their investments. In many cases the directors of companies have entered into a more liberal policy, one more in accord with the necessity and requirements of the business. In some cases, notably in New York, Chicago, Baltimore and Pittsburgh, new buildings have been erected suitable for carrying on the business in which we are engaged. In some other cases either new underground systems have been laid, or existing plants have been extended. Multiple switch boards have taken the place of old and worn out systems that were a constant source of discomfort to subscribers and telephone managers. In other cases larger poles have been erected; copper wire has largely taken the place of iron and steel, and good insulation has displaced poor, or perhaps no insulation at all. But while much has been done, much more remains to be done in the next three or four years, if the members of this association desire to retain control of the business which they have created and developed. In the sphere in which we move and perform our work we may be kings, but there is a greater circle beyond that, in which a constant power is being exerted that will in a very short and limited time compel us all to give the best of service and at the cheapest cost—so cheap, in fact, that your competitor of the future may well hesitate at the threshold before entering the field with hopes of successful venture. But the day of the inevitable conflict is sure to come, and it is your bounden duty to your stockholders and in justice to yourselves to prepare for that day. The maxim, "In days of peace prepare for war," or "Make hay while the sun shines" are worthy of your serious consideration. It will not do for you to fold your hands and rest content with the fruits of the legal victories of the American Bell telephone. The competitor of the future will be no less relentless than the infringer of the past. Watching every movement that you make, noting every step of progress, he is but waiting for the day and the opportunity either to divide the business with you or perhaps to absorb it entirely.

E. J. HALL, jr. on behalf of the American Telephone & Telegraph company invited the members of the association to take a drive the following afternoon through Central and Riverside Parks. The American Bell Telephone company extended an invitation to an excursion on North River, on Thursday, leaving at half-past ten and going probably as far as West Point, having dinner about six o'clock.

H. B. THAYER on behalf of the Western Electric company extended an invitation to the members to take lunch the following afternoon at Mount St. Vincent in Central Park after the drive.

The invitations, including one from the Electric club, were, on motion, accepted with thanks.

THE PRESIDENT: The next matter of business before the association is the reading of a paper by F. A. Pickernell.

NOTES ON TELEPHONE BATTERIES.

BY F. A. PICKERNELL.

I shall not attempt in these notes to recommend or describe any particular battery, but shall content myself with pointing out defects existing in the batteries now commonly used for transmitters, and emphasizing the importance of certain features which all telephone batteries ought to possess.

The selection of batteries for transmitters has always been a matter of considerable importance, although not

always recognized as such. When the battery transmitter was first introduced, nearly all telephone wires ran on overhead structures, no cables being used. The retardation in these circuits was consequently slight, and it was during this period of the business that the large margin in transmission was observed, it having been found possible to talk with the same ease over circuits fifty miles long as it had previously been over circuits a mile longer. This led naturally to poor construction, lines being built with small gauge iron and steel wire, and in many cases without insulators. Such construction cut down this margin of transmission to such an extent that it was found impossible to talk over such lines in bad weather, unless the transmitter and battery were in the very best condition.

Better construction followed, and with better construction the battery problem was of less importance. More recently, however, the extensive introduction of cables has again cut down the margin of transmission. This of course renders it necessary to keep the transmitter and its battery in better condition As the cable system of any telephone exchange increases, in a like ratio will the importance of the battery problem increase It was only last week that a gentleman was telling me of his experience in confirmation of this. His company had a cable two and a half miles long which not only had a high electro-static capacity but also a high resistance. This cable was used mainly for trunk wires. It was noticed that many subscribers who had no difficulty in talking with parties in their own exchange, had considerable difficulty in talking with parties in the other exchanges connected through this cable. Upon inspection it was found that invariably a poor battery was found at the subscriber's instrument. This cable made a very good battery inspector and one, I may say, that did not ruin the transmitter in inspecting.

The battery most commonly used for transmitters is of the Leclanche form. The little attention required by a battery of this class, its freedom from violent acids, the ease with which it is set up, its small consumption of zinc, there being no consumption when the battery is on open circuit, all unite in making it the leading form of telephone battery. However, it polarizes rapidly, and has a high and constantly increasing internal resistance when worked over a low resistance circuit, as it invariably is when used for transmitters. The importance of low battery resistance is shown clearly by the following considerations.

The efficiency of any transmitter, other things being equal, is proportional to the variation in current strength produced in its primary circuit, the greater the variation in current strength the greater being the efficiency. The variation in current strength being proportional to the variation in resistance, it follows that the efficiency of any transmitter is proportional to the variation of resistance produced in its primary circuit. The following table calculated for a Blake transmitter shows how important is the part battery resistance plays in modifying this variation in resistance, in other words, in modifying the efficiency of the Blake transmitter.

This table assumes the variations in a Blake transmitter to be from 5 to 15 ohms, these figures being the result of many measurements.

Table for Blake Transmitters. Resistance of Primary Circuit of Induction Coil .5 ohms.

Battery Resistance	Minimum Resistance	Maximum Resistance	Ratio of Min. to Max.	Percentage decrease of ratio from that of battery of no resistance
.0	5 50	15.50	1:2 82	
.33	5.83	15.83	1:2.72	3.5
.67	6.17	16.17	1:2 62	7.1
1.00	6.50	16.50	1:2.54	9.9
1.33	6 83	16.83	1:2.46	12.8
1.67	7 17	17.17	1:2.39	15.2
2.00	7.50	17.50	1:2 33	17.4

Two ohms is not an uncommonly high resistance for Leclanche batteries and from the table we see that the variation from its minimum resistance to the maximum resistance of the primary circuit of a Blake transmitter decreases from a ratio of 1:2.72 in the case of a battery of .33 ohms internal resistance to a ratio of 1:2.33 in the case of a battery of 2 ohms resistance, a decrease of 14 per cent.

With long distance transmitters the battery resistance is an even more important factor as will be seen by the following table: This calculation for long distance transmitter assumes variation in resistance to be from 4 ohms to 20 ohms; resistance of primary of induction coil .45 ohms. Three cells of Leclanche batteries are generally used with this transmitter.

Battery Resistance.	Minimum Resistance.	Maximum Resistance.	Ratio of Min. to Max.	Percentage decrease of ratio from that of battery of no resistance.
.0	4.45	20.45	1:4.60	
.33	5.45	21.45	1:3.94	14.
.67	6.45	22.45	1:3.48	24.
1.00	7.45	23.45	1:3.15	32.
1.33	8.45	24.45	1:2.89	37.
1.67	9.45	25.45	1:2.69	42.
2.00	10.45	26.45	1:2.53	45.

From this table we find that the variation is decreased from 1:3.94 when batteries having internal resistance of .33 ohms are used to a ratio of 1:2.53, when batteries of 2 ohms internal resistance are used.

These tables likewise show why it is that even a slightly defective joint in the primary circuit prevents the action of the transmitter.

Polarization is a defect of even more importance than internal resistance. It is not uncommon for a Leclanche battery to decrease 30 per cent. in e. m. f. after ten minutes' use. This of course decreases the average current in the primary circuit of the transmitter in a like ratio.

Having noticed now the importance of low and constant internal resistance and constant e. m. f., I will next call attention to some of the causes which operate to render telephone batteries not only poor to start with but unreliable in service. Lack of porosity in the porous cups is frequently the cause of high battery resistance.

Commonly porous cups are found which contain peroxide of manganese dust. This dust should never be admitted, as it invariably increases internal resistance. The peroxide should be in particles about the size of small peas. Binding posts are frequently found which do not make good connections with the electrodes. The binding post on the carbon plate is often found after a few months' use to be almost entirely insulated from the plate. This is caused by the salts creeping up through the carbon, and corroding the metal binding post. The upper portion of the carbon is supposed to be entirely impregnated with paraffine to prevent this crawling, but very often the carbon is not soaked long enough to become thoroughly saturated. Care must be taken not to use an excess of sal-ammoniac in setting the battery up, for otherwise crystals will form on the zinc increasing very much the internal resistance. If the sal-ammoniac becomes impoverished a complicated chloride of zinc will deposit in the same manner. A poor quality of the peroxide of manganese is frequently found in porous cups. When such is used polarization takes place very quickly

Gravity batteries and bichromate of potash batteries have been used to a considerable extent especially for long distance transmitters. These batteries require much more attention than the Leclanche battery, and are not so reliable. The battery which in its electrical properties approaches more nearly the ideal battery, is the storage battery. This combines constant e. m. f. with very low internal resistance. Two cells of storage battery on a long distance transmitter give the very best transmission. This form of battery cannot, of course, be generally used on subscribers' instruments.

Many modifications of the Leclanche battery have recently been introduced, some having remarkably low resistance, but they all polarize more quickly than is desirable. I think that if we have not already a modified Leclanche battery that combines low resistance with constant e. m f. that we will soon have one and this will be beyond question the telephone battery of the future. I see no reason why a battery of this kind could not be made having an internal resistance of considerably less than .5 ohm and a constant e. m. f. of 148 volts. This battery could be put up in a package with nothing but the terminals projecting and these I may say should be provided with the best possible forms of binding posts. By using nothing but the best material and properly designing the electrodes, polarization could to a very great extent be prevented, and by properly proportioning the components exhaustion would take place in all the parts at about the same time. Such a battery would give, when set up, the very best possible results and would require no inspection. When the battery became exhausted no unsatisfactory doctoring would be done by the inspector; he would simply replace a battery by a new one. Until some such battery is generally introduced we may expect about the same percentage of battery troubles that we are now having.

MR. GIFFORD: I have not the pleasure of knowing the gentleman who just read that paper, but I understand he is comparatively a young man with us. I want to say that while we have discussed conductivity, resistance, insulation, and all those topics until they have almost become chestnuts, this is really the first exhaustive and specific paper on the subject of batteries that we have ever heard, I think. It is a very valuable paper and I move that we return the thanks of the association to the reader of the paper.

MR. BULLOCK: I propose, in connection with that vote of thanks, that the paper be made a part of the minutes and published.

MR. GIFFORD: I intended to include that.

MR. BAILEY asked a question of Mr. Pickernell in relation to storage batteries.

MR. PICKERNELL: The batteries I referred to were the old form of Brush, the first form that came out. I should say that the size was about five by eight by twelve. The two cells of storage battery had two plates each, and the resistance was very low indeed. I did not use the batteries after the electro motive force had commenced to drop out appreciably.

MR. BAILEY: They are made up of two plates each, one positive and one negative.

MR. PICKERNELL: Yes, sir.

MR. BAILEY: Seven by twelve inches?

MR. PICKERNELL: Yes, sir; something like that. I could not get at the dimensions of the plates exactly. The experiments were made about two years ago.

MR. GIFFORD: There is one other question I would like to ask. I noticed that Mr. Pickernell in his paper mentioned the fact that he used the Leclanche cells usually with the long distance transmitter. I wish to say that we have several of them in use. I started out rather on my own hook to see how many cells were wanted. I commenced with one, two and three, and I carried it up to four, and on the line on which we have them in use I found that four cells gave the best result. But I assume that I have a good deal to learn on that subject, and I would like to hear from some of the members, in the eastern states as to what they usually use, and what number they find produces the best result, and what battery will go farthest. While I do not wish to have the association espouse the interest of any particular battery I would like to know what battery has been found to be the best for long distance transmitters. That is a practical question that we can discuss here without reflecting upon any particular battery, I think. As a matter of fact we want to get at the very best battery.

MR. SEELEY: I would like to state to members of the convention that the Metropolitan company of New York are putting in a storage battery for their transmitters, especially for the exchange work. We are about to use a cell we call "Type D," giving seven amperes of current; internal resistance about .005 of an ohm; two volts. Those batteries are about seven inches high by twelve inches square.

MR. LOCKWOOD: I scarcely need say that I for one was much pleased, with Mr. Pickernell's paper. I am glad to see that the younger men among us take sufficient interest in our work to take the time and pains to write papers for this association, and I am also glad to see that a spirit of discussion is abroad, because I think we learn just as much from the discussion and from the individual experience of the members as we do from the papers themselves, and sometimes the information we gain from the experience which is given is more valuable, in a practical way than that contained in the paper itself, whose real value must of course, always be that of the discusiion which it elicits. I trust that the discussion of the papers which are read at this meeting of this association will be more prevalent and universal than it has been.

I notice, however, one point in Mr. Pickernell's paper, which since it differs from my own experience, I think it proper to refer to especially. It may be that my experience is misleading and that I am wrong on this point. If I recollect right he stated that we were to be careful in the use of Leclanche batteries, not to use too much sal-ammoniac. If by using too much he means that we are not to fill the jars full and then try to moisten it, I agree with him. If on the other hand he means that we must be very chary about putting sal-ammoniac in, I cannot agree with him. As a matter of fact, I have found, in the course of some thirteen or fourteen years' experience in telephony and otherwise, that the amount which the dealers, especially the Leclanche battery company (which is very careful to send out nothing but good material) that the amount which they send out, of sal-ammoniac, is exactly the amount which it is proper to use. In my experience I have found that the amount they put up in their paper packages is just about the correct amount, and that we can neither diminish that nor increase it to advantage. It is true that crystals will form upon the zincs and upon the lower part of the zincs, but as long as crystals of sal-ammoniac only fall on the zinc no great harm will come. It is also a fact that when there is a little sal-ammoniac in the solution, oxychlorides of zinc and ammonium at once form on the zinc, and these salts being insoluble, take away so much of the conducting surface of the zinc and thus increase the resistance of the battery, besides preventing the necessary consumption of the zinc which is absolutely essential to the proper working of a battery. I did not notice any other point in the paper that I should care to criticise at all, and it may be that this is simply a difference in definition. I dare say when Mr. Pickernell comes to restate his views they will be found to be not far from this which I have enunciated.

I am also glad to note from what Mr. Seeley says that the Metropolitan company is making an experiment in the way of using secondary cells. I should like, if I may be allowed, to place myself in front of the association for the moment, to request Mr. Seeley to do, what I have no doubt he will do, to make a careful observation of the result of such batteries, so that at our next meeting we may be enabled to know something about it. Of course, if we had a storage cell, if we had a secondary battery with just sufficient voltage and furnishing just sufficient current for our needs, no doubt that would be the ideal cell. If we should use such a cell, of course we should be subject to the necessity of recharging, but the Leclanche cell is not wholly free from such disadvantages. The best batteries we have had in our telephone work have to be looked after. In 1882, when I was in Cincinnati on a short visit, I found that the Cincinnati service was far ahead of anything that I had ever seen in any exchange before, and when I came to look into the matter I ascribed it more particularly to the constant inspection and the great care exercised by the city and suburban telephone association of Cincinnati in looking after their batteries.

MR. PICKERNELL: I would state that I quite agree with Mr. Lockwood in respect to his statement about the use of sal-ammoniac. I mentioned that fact because I found that it was not infrequent for telephone inspectors to put in two of those packages of sal-ammonia instead of one, thinking that by so doing they might possibly save a trip there in a short time. It is only about two weeks ago that I found three cells of battery which we were using on a long distance transmitter in which the zincs were entirely covered with crystals of sal-ammoniac. The reason my attention was called to that fact was that the transmitter would not work at all; still there was a circuit; you could get the click all right when you moved the telephone hook.

THE PRESIDENT: How many ounces of sal-ammoniac does the Leclanche company furnish?

MR. PICKERNELL: I think it is four ounces.

MR. GIFFORD: It used to be six

MR. PICKERNELL: In reply to the gentleman's question about the number of cells to be used with long distance transmitters, we find, if we use low resistance batteries, that three cells are as good as four, there being practically no difference. But if you have batteries in which the resistance is increased from any cause whatever, it may have been unusually high resistance, you will find that four batteries are better than three In other words, if you should try to make the experiment by first putting on one battery and talking, and then two and three and four, if you start with a battery having high internal resistance, you will find four will be enough. On the other hand if you use batteries with low internal resistance, you will find three quite as good as four. Of course with three the chances of trouble are less than with four

MR. GIFFORD: In selecting batteries for our long distance work we are very careful to see that our batteries are as nearly perfect as possible. When the millennium comes, I suppose we shall have perfect batteries; not before. I

am always very careful to select good batteries and I have found that in some instances four cells give better results than three, although three have worked very well.

One word in regard to sal-ammoniac. That is one of the questions that vary somewhat in different localities. A short, practical rule that I have adopted is to allow an inspector to put in no more sal-ammoniac than you can dissolve in water. I do not leave any at the bottom of the cell at all. I found, as Mr. Lockwood says he found, that they will load up a cell with two or three charges, so that they will not have to go back. The amount dissolved varies according to the kind of water in different towns. In a town where you use lime water it will not hold so much sal-ammoniac in suspension as pure river or rain water will, and in some places where you happen to have water strongly charged with some mineral it will not dissolve very much. I mention that more as theory than practice. Of course I do not suppose it will make a variation of half an ounce in practice.

MR. THORNBURY: I would like to ask the gentleman if he finds any deposit on the zinc on the treatment of the battery which he carries out

MR. GIFFORD: Sometimes. When I am careful not to overcharge the battery I do not find nearly as much. I presume there is hardly any battery in which, if you use it long enough, there will not be more or less deposit of zinc Where you do not overcharge it the deposit is not nearly as much.

MR. THORNBURY: I was going to say that in my experience I rather favor the disposition of the batteries described by the gentleman who last spoke, in placing just enough sal-ammoniac in the battery to keep it doing its work I find that the battery if it is put to hard work even though it has just sufficient to do the work without more, will deposit these crystals on the zinc. They are insoluble and therefore the battery has no zinc in contact with the solution. For that reason we get no current. The value of any battery is proportionate to the current it will give us That is determined by the internal resistance.

I want to say, in reference to the long distance telephone, that where hard work is being done the Leclanche battery will hardly answer the purpose, if it is in an exchange where it is used frequently; but a four or six cell gravity battery will serve the purpose just as well That is to be determined by the length of the line in which you wish to work it or the condition of the battery itself. The sulphate of copper battery, or gravity battery, as we call it, has to be constantly at work, or it will polarize itself. If it is constantly at work and cleaned once a week, the gravity battery will give splendid results and give you splendid transmission for your long distance telephone; but we determined some years ago when this telephone first came up that four cells of the Leclanche battery were the best. The first experiments we made were with the Fuller battery. We used three of those, which gave us six volts, and the internal resistance was about the same as the Leclanche. Then we used the four Leclanche cells, which gave us in the neighborhood of six volts.

MR. BAILEY: The point aimed at seems to be to get an effective working battery of low internal resistance. The gentleman was speaking of the use of a storage battery. Why isn't that of some value? Has any one experimented with the Leclanche batteries on any kind of telephone in multiple? In using them in multiple you would get much lower internal resistance, I should say, and of course a greater quantity of current.

MR. LOCKWOOD: I did not intend to say anything more on this head, but since the gentleman from Pennsylvania inquires, I might add that some two or three years ago the chief clerk of our company, R. W. Devonshire, sent me two or three transmitters with the instruction—I don't know whether it was directed to me specially, or whether it was in the nature of a circular—which gave me the exact information how much battery I ought to use for the long distance transmitter. I did not follow the instructions with great care, and I tried them with a number of cells of different kinds. I tried them with one, two, three, four cells of Fuller and different bichromate combinations. I tried them with one, two, three, four, five, six cells of Leclanche and other similar batteries, and I tried them, as Mr. Bailey has spoken of, three in tandem and two abreast, three in series and two in multiple arc, and I found that while that arrangement was new it worked beautifully. It furnished the proper amount of current, or at least it furnished a very good amount of current, and it worked very nicely; but when that battery grew a little older I found that it did not work as well because it was impossible to make the two sides work alike—one side got a little stronger, and kept getting stronger, than the other. Consequently, instead of both points of the current going this way the stronger battery took a notion to polarize or go against the current of the other side. While it was new it worked very nicely, but after two or three weeks it did not work so well. A better way would be to do, what I am surprised battery manufacturing companies have not done before, is to make a larger Leclanche cell. Possibly they have done it before, but it has not got into the market. A demand has come, however, for a Leclanche cell about twice the size of the present cell. I have a Fuller battery under my desk, and it has worked unchanged for eight months. It works pretty well, and you could not tell from its operation that it was an old battery, or that it had not been cleaned for eight or nine months. As there are only two cells it does not make much gas, and does not annoy me at all. But while acid is good in an office like mine or in the headquarters of a telephone company, it is not good for subscribers' stations. I think that we shall have to put our trust still in the peroxide of manganese battery until we can find that peroxide of lead is as constant as peroxide of manganese, and it is a proper thing, I think, for manufacturers to consider whether they had not better increase the size of them.

The point mentioned by Mr. Gifford or some other gentleman that the batteries which the Leclanche Battery company once provided six ounces they now only provide four, that can be accounted for by the fact that there are several sizes of Leclanche batteries, and they have provided six for the larger size and four for the smaller size, and it is always economy where we are buying for telephone transmitters, to buy the larger size.

MR. SEELEY: The present plan of the Metropolitan company is to make an inspection once every month. The solution is thrown out and a new solution made up. Each inspector is provided with a measure holding four ounces of sal-ammoniac. We guard against overcharging the batteries in that manner. We find that the Gonda porous cup is about as good as the Leclanche battery. Taking the current at the electrodes of the battery we find that we get one and seven-tenths volts, with an internal resistance of one and seven tenths ohms. After using that battery through a resistance of eight ohms for five minutes, we find that the voltage falls to one and three-tenths, a current of five-tenths of an ampere, and the internal resistance has increased to two and six-tenths volts, etc., down to the short circuiting of the battery. For an hour and five minutes we get three-tenths of a volt and three-tenths of an ampere, and one ohm internal resistance. That battery was far ahead of any we experimented with.

THE PRESIDENT: The association will now adjourn to meet again at half-past 2 o'clock in executive session.

Wednesday's Proceedings.

The meeting was called to order by President Metzger at 10 A. M.

THE PRESIDENT: The first business before the association this morning is the reading of the paper by C. E. McCluer

MR. MCCLUER: In consequence, I presume, of the fact that I had unusual facilities for observing the action of dynamo currents upon telephone exchange systems I have been invited to prepare and read before you this morning a paper on dynamo currents and their influence upon the telephone exchange systems and means of prevention. I have endeavored, of course, in the preparation of this paper to make it popular as far as I could, in character, leaving to our friend, Mr. Lockwood, the discussion of the subject from a scientific standpoint.

Mr. McCluer read the following paper:

DYNAMO CURRENT INTERFERENCES WITH TELEPHONE SYSTEMS AND MEANS OF RELIEF.

BY C. E. MCCLUER.

During my earlier telegraphic experience I became imbued with the universally accepted belief in the theory that the earth was an immense reservoir of electricity, and that on that account, and because of its immense mass, it offered no appreciable resistance to the transmission of electrical force. Hence the universal use of the earth as a return conductor for telegraph and other electrical circuits, which are in consequence called "mixed circuits," in contradistinction to circuits composed wholly of metallic conductors. But my attention being called to the behavior of our telegraph apparatus under the influence of extraneous currents, I was finally led to question the correctness of the theory of the "infinite conductivity" of the earth.

Like nearly all of the early workers in the new field opened up by Prof. A. Graham Bell's invention, I was also led into the error of attributing to "induction" nearly all the ills to which the telephone was heir.

Experience and observation, however, soon convinced me that nearly all the telephone troubles popularly supposed to arise from "induction" were the result of a "leakage" only; induction operating only at minute distances, while leakage will occur across wide intervals. Hence I was to some extent prepared for my subsequent experiences with the effects of electric light and electric power circuits upon telephone systems, experiences which, as I will now proceed to explain, confirmed me in my disbelief in the theory of "infinite conductivity" and the effects of "dynamic induction."

Some three or four years ago, Richmond was captured by the advance guard of the army of Knights of the Dynamo, to which she is now so largely tributary, and the Schuyler Electric Light company soon had the city ablaze with arc lights. At first we experienced little or no trouble, but after a time strange noises were heard in our exchange telephones and as the electric light construction was extended and circuit and arc lights were multiplied, the noises increased until it finally became a din over which it was impossible to project the voice. After careful consideration, I suggested certain reversals of dynamo currents, and rearrangement of the electric light metallic circuits, which were adopted by our electric light friends, greatly to our relief. But on some of our exchange wires, notably those on our Broad street trunk line extending to the extreme western and northwestern limits of the city, the howling of the dynamo currents remained comparatively unabated. After further consideration I became convinced that the principal source of our telephone troubles was a long electric light circuit, which traversed Main street to the western limits of the city, then crossed northward to Broad street, which it followed eastwardly to a point opposite the power house, and thence in a southerly direction to the dynamo, thus making a loop about a mile and a half in length by a quarter of a mile in width. One side of this loop ran parallel with our Broad street trunk line, almost the entire length, with only the width of the street between them. I was at first inclined to attribute to the usual scapegoat "induction" the interference which we experienced on our Broad street wires, but my attention being about this time directed by some of my linemen to the interesting fact which they had discovered, that even in dryest weather enough of this dynamo current on this large loop escaped over the insulators and down the poles to be perceptible to the tongue when applied to a pole four or five feet from the ground, while in rainy weather a very perceptible shock could be felt by applying the hand to a wet pole.

My former opinion regarding "induction" vs. "leakage" and the "infinite conductivity" of the earth were recalled to me with a redoubled force, and I soon settled down to the conviction that leakage was the force with which I had to deal. This conviction was strengthened by the well observed fact that the interferences from the electric light currents were greatly increased during wet weather.

But the famous Richmond Union Passenger railway, with its street cars propelled by electricity, became a moving, flashing reality in January of the present year, and for a time rendered the telephone business in Richmond decidedly interesting. Unlike the electric light and power systems, the electrical plant of the railway company was not designed or arranged for metallic circuits, but was, and still is, operated by mixed earth and metallic circuits, the currents being carried to the overhead trolley wires by a system of distributing mains, supported upon poles on one side of the street, these mains being connected at frequent intervals with the trolley wire by short lateral wires, termed "feeders." As operated in Richmond, the electric railway system requires a double line of poles, one line on each side of the street, for the purpose of carrying short non-electric wires which extend across the street between each pair of poles. These are termed "supporting wires," and are designed solely to support the trolley wires at the proper height above the middle of each roadway. These trolley wires are designed to furnish current direct to the motors in the cars by means of a trolley, which in some systems rides on top of the trolley wire, and which, in other systems, as is the case with the Sprague system in Richmond, rides underneath the trolley, where the trolley is supported on the end of a flexible pole attached to the top of the car, and then extending up underneath the trolley wire, and revolving, of course, as the car makes its way over the track. The current then passes down through the motors, and then to the earth.

MR. LOCKWOOD: A single wire?

MR. MCCLUER: A single conducting wire.

MR. GIFFORD: And a bare wire?

MR. MCCLUER: Yes, sir.

These supporting wires and the network of special supporting or curve wires whose office it is to cause the trolley wires to curve parallel with the curves in the road bed, are supposed to be insulated from the trolley and feed wires and mains, but, as found to our cost, they were not by any means devoid of electrical currents. During the first six weeks after the inauguration of the electric road we had eight sets of telephones and one central office annunciator drop burned out by the railway currents, and about half of these accidents were due to crosses between our telephone wires and the supposed to be harmless supporting wires. While these accidents demoralized our linemen and operators to some extent, they fortunately resulted in but little damage to property, and none whatever to human life; and but few of our subscribers learning of them, they created no special commotion.

But the effect of the railway system upon our central office apparatus and telephones, from the very inauguration of the railway plant to the present time, has been annoying in the extreme, and exceedingly detrimental to our exchange service. Almost the first revolution of the battery of railway dynamos tripped the annunciators of our magneto lines, and rendered necessary an immediate resort to the use of special armature springs to overcome the magnetism imparted by the currents from the railway wires. Our "testing-off" galvanometers were rendered inoperative, because at the first the polarity of the extraneous currents was opposed to that from our galvanometer batteries, and the galvanometer needles were deflected in a direction contrary to the position assumed when under the influence of the batteries alone, the leakage from the railway wires being sufficiently strong to overcome the current from the three cells of Law or Leclanché battery.

This trouble I remedied by reversing the poles of my galvanometer batteries so they would, with the exception to be mentioned, coincide in polarity with the extraneous railway currents. And this exception, coupled with the continuous and steady nature of the extraneous currents, confirmed me in my belief that it was leakage, and not induction, from which we were suffering.

At the power house or dynamo rooms of the railway company, distant three or four squares from our central office, the battery of five or six dynamos which furnished the current for the car propulsion, was grounded, the negative electrodes being connected to several large sheets of copper at the bottom of a deep well upon the premises, the positive electrodes of the dynamos, coupled up, of course, in multiple arc being connected "to air," as a telegrapher would put it, or to the distributing mains. From all of our exchange stations located in the vicinity of the dynamo room, within the radius of an entire block in fact, we would therefore get a negative leakage current, while from all other stations which were grounded within a square of the railway track and wires, we would obtain a positive current, thus rendering it impossible to arrange our galvanometer batteries to coincide with these leakage currents of opposite polarity

We cannot, therefore, to day, use our galvanometers for "testing off" the few stations located in the immediate vicinity of the dynamo rooms. Identically the same effect was produced upon our head phone test circuits, the railway currents completely neutralizing the currents from our "test" batteries. This difficulty was also remedied by reversing the poles of the batteries.

The exchange lines most greatly affected by the railway currents we found by experience were those which were grounded nearest the railway tracks, irrespective of the general direction of the wires or their proximity to or distance from the railway, lines that in no place approached within less than a square of the railway wires being as greatly affected as many others that ran parallel with, and in close proximity to the railway wires for long distances, but which terminated and were consequently grounded at points comparatively remote from the railway, We had a trunk line extending down Bank and Franklin streets, but on one side of those streets, while the railway mains occupy the opposite side of the railways with the exception of the distance between 9th and 12th streets. That was

straight and rather narrow, and was bordered on the north side by a handsome row of shade trees adjoining the Capital square. These trees our city engineer strenuously objected to cutting or trimming for the railway wires. We were compelled to accede to his demand that we should allow the railway wires to be carried on the poles that distance from 9th to 12th streets; yet the interference that we received from these railway currents was heavier on wires that did not run down Bank and Franklin streets at all, but which left the central office and went directly away from the railway two squares to Carey street, and down Carey street a mile or a mile and a half and then north several squares and grounded near the eastern terminus of the railway track. In those wires that did not run parallel with the railway wires at all our interferences were heavier than with those wires that were strung on the same poles with the railway wires for those three squares.

In like manner lines grounded near the heavier grades and curves of the railway where the motor men are compelled to use the maximum amount of power in order to ascend the grades or round the curves with heavily loaded cars, are more seriously affected than lines grounded near the levels. So clearly is this the case that our operators can readily tell from the character of the disturbance which they experience, when a car is ascending a grade, or when it stops or starts.

This effect of the movement of the cars you, of course, understand is due to the fact that the dynamo currents, when propelling the cars, are short-circuited from the trolley wires through the motor fields and armatures to the earth, thence spreading over every available conductor in their efforts to reach the dynamos. But the maximum disturbance is experienced when three or four cars are following each other in close file, either on a grade or level. In that case the leakage due to each car traverses the contiguous telephone wires simultaneously, producing in our telephones a composite or mixed tone, each motor having its distinctive "timbre" or tone quality, and all united fairly making Rome —or the telephone, rather—howl and drowning out the puny currents induced by our microphone batteries.

Learning that the railway people were utilizing the municipal gas and water mains in order to reinforce their ground connections, it occurred to me that possibly the fact of our lines being generally grounded on the gas and water pipes had much to do with our troubles. I had some of our wires removed from these systems and connected direct to the earth through made grounds, but without altering the results.

The 450 or 500 volt currents of the railway mixed circuit system do not, however, interfere as gr atly with our Richmond exchange service as the 4,000 or 5,000 volt currents carried by the metallic circuits of the electric lighting systems. Did the railway service require currents of the same e m. f. as the arc lights, the telephone would have to retire from the field,—lose ground, in fact—as metallic circuits would be their only salvation. What the railway currents lack in e m. f., however, they make up in current strength, and are, therefore, more dangerous to property than the much more intense electric light currents. The latter will melt a fuse or burn out an arrester instantaneously before time is given it to enter a central office or a subscriber's station, and damage the telephone or outfit; while the less rapid but larger quantity of the railway current takes an appreciable time to melt or fuse an arrester, thus permitting it to burn out a hand phone, and induction coil, or a bell or annunciator magnet, before the protector, of whatever kind it may be, can properly act

In my experience the greater tension of the electric light currents renders them doubly disastrous to telephone exchange service, the voice being more completely drowned by the intense disturbance due to the electric light escape than it is by the escaping currents from the lower tension dynamos. But the fact of the electric light being in demand, particularly the arc lights, only after business hours, renders the disturbances engendered by them less noticed by subscribers generally than the weaker and less marked disturbances proceeding from the railway generators, which are continuous thr ughout the entire business hours of the day, when the telephone service is in constant demand Did the arc light service continue during the hours of daylight as at night, telephone exchanges would be compelled to suspend operations or adopt the only alternative, metallic circuits, with the attendant increase in complication and expense.

As a matter of course, in larger cities where there are a multiplicity of electric lighting systems with power houses distributed at intervals all over the city as it were and with a multitude of circuits and currents going backward and forward, and neutralizing each other by being carried down in one direction on one line of poles and in another direction on another line, of course the disturbances are not as great as in a small place like Richmond, where the currents are all in one direction and on one line of poles, as is the case with this large circuit.

Having thus discussed the effects of extraneous electric light and railway currents let us address ourselves to a brief consideration of the remedies which we have at hand. Anti induction devices for the elimination or exclusion of extraneous currents from telephone circuits, whether they be artificial or natural, are plentiful, but none have yet been devised that can at all compete with the old style metallic circuit.

But the metallic telephone exchange system carries with it not only a double expense for construction, maintenance and repairs, but a vast outlay and increased complication and expense for central office plant and service, there being two line wire terminals to provide for every subscriber, and necessarily four terminals to handle for every connection, instead of two, as with the single wire and earth system.

This great increase in wires, in complication and consequent liability to derangement, and in initial cost, and subsequent expenses for operation and maintenance, almost prohibits the adoption of the ordinary metallic system. None but the wealthy, like our long distance friends, can afford such a luxury. But there is a metallic circuit system within reach of even the poorest of the American Bell Telephone company's lessees, a system of my own devising, and which I have found by practical tests to accomplish all that can be desired from an ordinary metallic circuit, and at but a tithe of the expense

Recurring now to my theory that it was not "induction," but leakage, that annoyed us, and the expression of my disbelief in the infinite conductivity of the earth, it will readily be seen how after arriving at those conclusions I would very naturally reason thus: If our telephone troubles are due to leakage from the electric light and railways, and this leakage overflows into our wires from the earth because the earth offers an appreciable resistance to their passage, why cannot we adopt a metallic conductor of exceedingly low resistance, or of a conductivity approximating that of the earth, and use it in place of the earth as our return conductor, making it, in fact, what may be called an "artificial" earth or ground, and at the same time cutting loose from the earth entirely, and gaining all the benefits of metallic circuits?

This idea I conceive to be in strict conformity with Ohm's law, and if only the relative resistance of the "artificial ground" or earth and the line wires attached to it were properly adjusted, we would have identically the same results achieved by the usual earth connections and without the disadvantage of the mixed circuits. This thought revolved in my mind for some months before I could find time and opportunity to verify its truth or falsity by experiment. Besides, the device was so simple that I could scarcely conceive that it was possible that it had not already been tried and found to be impracticable by some member of the army of electricians that had been so long engaged in efforts to solve the anti-induction problem; and it was only after conferring with some of my brother telephonists, who were favorably impressed with the idea, which was novel to them, that I took the time necessary for experiment. I however, finally connected up several telephone circuits with a common return wire of low resistance, and found that conversations could be carried on, and a magneto call bell rung on each circuit without any mutual interference whatever, and it required a resistance of 35 ohms by galvanometer measurement to be added to the common return wire before the currents propagated in one circuit could be heard in the telephones on the other circuits. I thus concluded that there was approximately 350 ohms resistance in each circuit, due to the conducting wire, the call bell magnets and the hand phones, and transmitters, and that the "artificial ground" wire should bear to the other side of each circuit, the direct or line wire, a resistance approximating one-tenth that of the entire circuit.

Encouraged by this experiment and anxious to do something to improve the night service of my exchange, I laid my scheme before the executive officers of my company, and was furnished with a half mile of No. 4 copper wire with which to make some practical tests My first experiment was with our No 19 northern call wire and its connecting lines This was our shortest call wire, being only a third of a mile in length, and had connected with it some 18 or 20 subscribers' stations, located in close proximity to the Seventh street grade of the electric railway, an 8 or 10 per cent. grade, extending from Franklin to Grace street, one square. At the corner of Seventh and Franklin streets, the main feeder wires of the railway plant direct from the power house, two squares distant, first touched the line of the railway and divided right and left to the opposite and distant ends of the road. At this point, as might have been anticipated, on our telephone lines grounded in this vicinity we experienced the greatest interference, particularly when a heavily loaded car was ascending the hill. My "artificial ground" gave us immediate and remarkable relief from the railway leakage, and without any cross talk whatever I then applied for a half mile of No. 6 covered copper wire, which I connected to the end of the first half mile of No 4 wire, and extended artificial ground wire out to the western end of the city, intending to make my next test with one of our longest taps and our longest lines, with stations located near the most westerly extension of the long Main and Broad street electric light loop, of which I have already spoken. These lines had been almost entirely abandoned at night, our subscribers averring that they could not use their telephones at all after the electric lights were ablaze.

The worst of all was a station in a drugstore, whose proprietor had long made bitter complaint that his telephones were of no service to him after dark. Yet when the change was made from the natural to the artificial ground at this and all other stations on that call wire tap, relief from the electric light leakage was as instantaneous and marked as that experienced from the railway leakage on short tap No 19. In fact such was the change wrought on these wires that it was possible to carry on a whispered conversation over lines connected to my artificial ground, that when connected to the natural earth were so noisy that even the loudest shouting could be heard only with extreme difficulty.

While cogitating over my idea in its incipiency it occurred to me that even the adoption of a general ground wire of high conductivity would relieve our telephone wires from the influence of these extraneous currents to a great extent. This I found from experience to be true.

When arranging for the central office end of my "artificial ground," I had made a plug switch so arranged that by the insertion or removal of a single plug I could connect the artificial ground wire to earth, or disconnect it entirely from the earth, and with one motion connect it with all of its attached wires into a "compound metallic circuit system." I could thus readily note the difference made by the use of the large copper wire as a general ground wire, or as a substitute for the earth. In the one case, as you understand, if I have made the matter clear to you, the large copper wire was connected to earth at only one point through the plug switch in the central office, while in the other it was disconnected from the earth entirely. For fear I have not made this perfectly plain, I will interpolate here in a little stronger language if possible, the difference between these two arrangements. In the one case, using this large common return wire of large conductivity as a general ground wire, you will understand that all the stations on the route followed by this large common return wire were disconnected from the earth entirely, and the ground pole connected to this artificial earth instead, none of the subscribers' lines or stations being connected to earth at all, but all of them on the current generated by the microphone batteries seeking ground from this general ground, by the ground in the general office. But by means of this plug I have arranged so that I could at any time make such an experiment. By withdrawing this one plug I could detach this general wire from the earth entirely so that I had a system of purely metallic surface—no earth connection whatever.

MR DURANT: Allow me to interrupt you one moment. You say you disconnect by means of a plug from the earth. Now what was it that connected it at the central office?

MR. MCCLUER: I had one of the operators' head phones connected to that instead of the earth, and I also had one of the operators' sets of telephones in the central office connected to that in the same way; so that by putting the taps that had been changed from the natural to the artificial ground all on that one head phone I could place all those stations on one operator, or I could put it on my own ear so that I could receive all the orders given by subscribers over the metallic surface. There is no ground connection at all; the central office operator's head phone and this operator's telephone and transmitter being connected to the other end of the artificial ground, and of course connected inside, we may say, of the point at which the ground wire was connected on; there being two plates, one heavy brass plate to which this artificial ground and the telephones were connected, the other plate having nothing attached to it whatever, but the wire leading to the natural earth. As a matter of fact when the plug was in there all these connected stations got earth through this plug and ground wire, and when the plug was disconnected they were all disconnected from the earth.

MR LOCKWOOD: Then, Mr. McCluer, the subscribers lines were connected at the subscribers' stations. Instead of each of them being connected to its individual ground wire, a group was connected to one large return wire. Then, was the central office end of the large return wire connected to the central office ends of the individual wires when you took your plugs out?

MR. MCCLUER: No, sir; it is left open. You understand that we, the Southern Bell Telephone & Telegraph company are exploiting the Law system We do not use the magneto and of course we have no grounds on our wires in the normal condition at all. It is only when the line is connected to another line that there is a ground at each of the subscribers' stations, but none at the central office whatever.

MR. GIFFORD: That would not work in the magneto system.

MR. MCCLUER: It would work in the magneto system if you took the subscribers' lines and connected them to this artificial ground It is just as though you were taking a strip of earth extending the whole length of your route and digging that up and lifting it on your poles. In other words you look upon this wire in exactly the same light as you look upon the ground.

MR. GIFFORD: If you should cut your exchange wire and connect that to your return, what would be the effect? Have you experimented on that? In your Law system you have no ground.

MR. MCCLUER: I think it probable that what I have to say further may throw a little more light on that point: To those familiar with the details of a telephone exchange, it will be clear that some such provision for grounding or connecting artificial grounds to earth is essential, as long as any of the wires of the system remain in connection therewith, because of the necessity of connecting stations not yet changed to the artificial ground to those that have been thus changed, otherwise the one will be grounded and the other "dead open," and, consequently, inoperative. In this way I found by experiment that, when the large copper conductor was to earth at the central office, and being used simply as a general ground wire, the electric light and street railway interferences were reduced about 50 per cent., and when used wholly detached from, and wholly in place of the earth, they were reduced the other 50 per cent. or eliminated entirely. So I take this number nineteen tap, connect that into another artificial circuit by itself. I might put that on a single head 'phone and let one operator wear that. She would get all the orders over the call wire with perfect distinctness and without any trouble whatever, but when she went to connect a subscriber on that call wire to another subscriber in another quarter of the city whose station was still connected to mother earth, of course we would have the case I have mentioned here. The station of the subscriber that had not been changed to the artificial earth would be grounded, the other station would be dead open, and of course there would be no chance of any conversation except through the leakage that occurred to the pole. When my experiments were in progress I would receive an order from a subscriber on this metallic surface; I would repeat it to one of the operators, and the two subscribers would be carrying on a conversation; but the first thing said would be, "What is the matter? You sound as if you were a thousand miles away." They would get distinct articulation but in a much weaker tone.

You understand that when this general return wire was used as a general wire, all of the wires on such a tap being connected to this one ground wire and all seeking earth at the central office instead of at the point where the subscribers' station was located, it reduced the interferences from street railway and electric light currents at least 50 per cent.; so that where it was only with difficulty that you could make a man understand what you said, with this general return wire we can hear very well indeed.

MR GIFFORD: That general ground wire was grounded in the central office?

MR. MCCLUER: Grounded in the central office. But when made wholly detached from and wholly in place of the earth they reduced the other 50 per cent or eliminated it entirely. On the e stations I spoke of before the leakages from the electric light wires have been so strong that the subscriber could not use his telephone at night and the operator could not hear him with distinctness when he ordered a connection. Therefore he told me he never thought of using his telephone after the electric light had been started. As soon as I had this tap connected to one of these artificial ground connections I sent one of my inspectors to make some experiments. He called me over this general ground wire. The operator heard his order to connect with 180 which is the chief operator's telephone in the central office. I went to the telephone and talked with him without any difficulty at all. Then I removed this plug from the switch and converted that ground wire with all its attached wires into a metallic circuit and he and I then carried on a conversation in a whisper of course getting close to the transmitters, as you have to do under those circumstances. But I just mention that to show you the difference between the general ground wire and the metallic surface. Then when I made him take out the general ground wire and replace the old natural wire, the din from the electric light was so great that he could not hear a word. I then called the subscriber to the telephone and the very moment I spoke to him he said, "Hello, what have you done here?" I told him I had been experimenting to see if I could not relieve him of the trouble he had been complaining of. He says, "You have done it." I then took the plug out of the central office, disconnected the earth entirely and talked to him over the metallic circuit. He then expressed still greater wonder that the electric light was gone entirely; he could not hear a sound of it. I then made some remark in a whisper which he heard without difficulty and replied to me in the same way.

Now, of course in practice it is much more convenient to have this general ground wire, as I ought to call it now, grounded at the central office. It is more convenient to do it for the purpose of manipulation but the same effect would be produced if this general ground wire was carried to any other point in the exchange and grounded at a point remote from the railway or electric light plant. To continue:

By thus utilizing the large conductor, first, as a general ground wire to carry the microphone and signaling currents to the earth at the central office, or at any other locality remote from the offending electric light or railway plant, an exchange system can be gradually converted from a mixed metal and earth system into a compound metallic circuit system throughout, without any interference whatever with the service of the exchange, and to its manifest improvement during the time the change is being made. And when the last subscriber's line has been transferred from the natural to the artificial earth at the last station, it is only necessary to withdraw the solitary plug that still connects the system to the earth, and, presto! you have an exchange of purely and practically metallic circuits alone, with all the advantages of the ordinary metallic circuit systems, the one series of large copper wires extending out on the various trunk lines, but all united in one at the central office, answering fully the purposes gained by the ordinary duplication of each individual wire, and necessitating no change whatever in either central office or station outfits or appliances, beyond the simple substitution of the artificial for the natural ground.

In practice it may be found that a greater proportion than one-tenth the resistance of any one circuit may safely be given to the artificial ground wire, but my experience and experiments lead me to believe that it will be far safer and more satisfactory to keep the resistance of the artificial ground to one-twentieth that of the entire circuit

In any exchange circuit you have got wires of different lengths, from one sixteenth of a mile to two or three or four miles. I allude now to the wire of lowest conductivity. This artificial ground wire should bear to any direct wire, whatever its length may be, the ratio of one-twentieth of the resistance of the individual line, that making it advisable that the wire nearest the central office should be of large conductivity. Then as you go farther to the central office you may use a smaller wire—a number six; still farther, a number eight; still farther, a number fourteen.

In an exchange the size of our Richmond exchange, I advocate the use for each individual trunk route of a single copper conductor composed of a half mile each of No. 4 and No. 6 wire with No. 8 for lateral lines and the remaining distance to the farthest stations, with No. 14 to stretch from the poles into the stations. All of these wires should be of hard drawn copper with a good covering, and strung on the same poles and fixtures that carry the regular exchange wires, but insulated carefully both from them and the earth. And I should place these artificial ground wires at the lowest point on the poles, or the least distance from the sidewalk or ground, beneath all of the line wires if possible.

In this position the small amount of leakage currents that are attracted up the poles from the earth, whether from electric light, electric railway and power circuits, or earth currents, will be intercepted by the large copper wires, and by them carried to those points in the system where they will escape to earth again without any adverse influence upon telephone wires proper.

Now in my experience a great deal of the leakage we get from these extraneous currents comes from the leakage of the insulators and poles of the railway plant. With this wire it would be apt to intercept and carry all of these currents to earth at some point where they would be naturally disposed to go to earth in order to reach the other electrode of the source from which they emanate.

While in the absence of any direct experiments I cannot say positively that such will be the case; I believe, however, that if our long-distance friends will couple together so as to make of some eight or ten of their No. 12 or 14 copper wires practically a single low resistance conductor, they will find that this compound conductor will answer as an artificial earth or return wire for treble or quadruple the number of wires thus coupled together, while a single conductor of the same conductivity would double the capacity of their poles and the number of their metallic circuits. This is a matter of theory, but I am satisfied that if the comparative resistance of this artificial ground wire is kept sufficiently low below the resistance of the other wires, that it is practicable. In like manner, I believe the same principle can be applied to telegraph and electric light or power circuits, relieving them from the disturbing and damaging influences of earth currents and atmospheric electricity, and conferring upon them all the advantages of metallic circuits without the ordinary duplication of wires.

In conclusion, allow me to say that, while I flatter myself that I am charitably disposed and ever inclined to do all that within me lies to further the interests of the telephonic fraternity and increase the efficiency and value of our telephonic service, I do not think I am justified in assuming the role of public benefactor and giving my device away, even in the interests of science. Believing it to be novel, practicable and valuable, I have therefore conceived it to be my duty as well as privilege to apply for a patent, and my application is now pending, with, I trust, a good chance for a favorable decision.

MR. LOCKWOOD: If Mr. McCluer will permit me I would like to ask him one question, and that is whether he has made a point of having his return conductor parallel with his main lines.

MR. MCCLUER: Of course, in every instance I have only, so far, in the Richmond exchange provided one common return wire, that is up Ninth and Broad streets, and up Broad street to the western extremity with branches radiating along the lateral lines. Of course this wire is carried on the same pole and parallel to all the wires connected to it.

MR. LOCKWOOD: I would like to state, gentlemen, that I did not know Mr. McCluer was going to read a paper on this subject, or perhaps I should have chosen a different one; but when you hear me you will perceive that there is no collusion between us.

He is quite right, I think, in attributing a certain amount at least, of the disturbance, and perhaps nearly all the disturbance occurring from electric railways to absolute leakage of the electricity from the rails to the telephone wires; but like nearly every person who has at one time adopted one theory for certain phenomena and at another time another theory, I think he has become an extremist, and as is usual, the mean is the correct view. A great deal of our disturbance on telephone lines is still due to the old enemy—induction, and although the telephone business is eleven years old now, induction is still just as strong as it ever was. The troubles that electric lighting and especially arc lighting have given to telephone men are of two-fold character; first, of the character which disturbs the conversation; and secondly of the character which destroys the wires and apparatus. Within the last year or two we have become apprised of another enemy in the lighting camp, namely the alternating current used for incandescent lighting, and these are used not only through converters but also on direct circuits. The telephone line which runs from the Malden central office in Boston to my own house is a very much disturbed line indeed, and I allow it to remain there so that I can study the phenomena But we formerly had a Thomson-Houston direct arc lighting machine with a three plate commutator, and the noise was bad then; but lately they have taken to lighting Melrose, where I live, with incandescent lamps placed in a direct circuit and operated with an alternating machine, and the noise is now tremendous because the alternations are almost as quick as the telephone alternations, namely about two hundred per second.

Mr. Lockwood read the following paper:

THE ELECTRICAL RELATIONS OF TELEPHONE AND ELECTRIC LIGHT AND POWER CIRCUITS AND RAILWAYS.

BY THOMAS D LOCKWOOD.

This paper deals altogether with the disturbing effects of electric light and power currents upon telephone lines, and not at all with the dangers of imperfect construction and insulation; nor with the results and prevention of dynamo current crosses, there being sufficient in the latter branches of the subject for a separate and equally voluminous paper.

It will consequently be assumed for the purposes of this paper, that the important precaution of effectively insulating wires conducting heavy currents is observed and that "undertakers' wire" is as it ought to be a thing of the past. The telephone exchange business was commercially organized and established in the first months of 1878. Electric lighting as a commercial industry had its beginning in 1878 and 1879, but did not at first take root with the same degree of rapidity which characterized the exploitation of the telephone, and not until some years thereafter did it achieve popularity.

Consequently the telephone systems obtained considerable start, and were firmly established in nearly every city and town in the country before the organization of many electric lighting systems. It was not at the outset generally known that the telephone circuits would be annoyed by the presence and proximity of parallel electric light wires; and telephone companies were thus at first most liberal in permitting the erection near their lines, of foreign lines carrying heavy and widely fluctuating currents.

Yet a little thought and consideration would have laid bare this danger. We knew that the telephone current was itself of the most shadowy and almost intangible character in point of strength, and that to utilize it, such a supersensitive instrument as we all know the telephone to be, was actually essential; and we knew that because the telephone receiver was such a delicate electroscope, and so sensitive to electric motion, we had heretofore been much annoyed by mutual telephone induction; by telegraphic induction, and by miscellaneous induction. So, as I say, if we had carefully considered the matter, we might have foreseen the full extent of the electric light disturbance which is now being sustained.

But we did not foresee, and as a result of our lack of foresight, indiscriminate construction has ensued; and in consequence of improper construction, the business of many telephone companies has at certain points been directly or indirectly injured by the presence and operation of electric light wires, and an appeal to the courts has been rendered necessary.

Until within a comparatively recent period the disturbance resulting from dynamo current induction was, with an occasional and rare exception, limited to certain evening hours, and to the night, because during such portions only of the day were the lighting circuits in operation. But of late, in many places, the wires used in the night for lighting, are also used during the hours of daylight for transmitting power from the dynamo to large numbers of motors which may be widely distributed, and as this utilization is certain to have in the near future, an enormous expansion, we are compelled to face the prospect that even during the hours of business telephone wires are now liable to severe disturbances Therefore, it seems time to call a halt; we could be patient so long as we were only called upon to suffer from the "pestilence that walketh in darkness" but when we are also threatened with "the destruction that wasteth at noonday," it behooves us to have something to say about it Superadded to the above causes, we now find that electric railways are being introduced in rapid succession, and we find to our cost, that many of them are much more active than are electric lighting circuits in setting up disturbing currents in telephone lines; the disturbing current from electric railways being frequently sufficiently strong to vitalize the annunciator magnets of a telephone central station, and to actuate the drops.

Now, I have no quarrel with electric light and electric railway companies, considered as such. No man rejoices more heartily than I, in the triumphs of electricity, and in the tremendous spread of its usefulness; I recognize fully, moreover, that the lighting, power and transit utilizations of this mighty form of energy are fully as useful as is its function of carrying intelligence; and that these utilizations have properly become permanent institutions and, equally with our own, public conveniences. Nevertheless, we were first in the field, and although we may admire both the energy of the electric lighting current and the energy of its introducers, we must in our own defence be prepared to take the position that no new comer has a right to construct his plant in such a way that an established business shall thereby be ruined or impaired; and that if it be absolutely necessary to erect electric light lines in proximity to telephone lines, the construction must be of such a character as not to involve detriment to the pre-existing telephone lines. Can electric light and power lines be constructed so as to be near telephone lines without interfering with them? Certainly they can.

Consider how the disturbing currents originate. First: Most arc lighting circuits can set up considerable induction on telephone lines Second: Alternating currents in main wires, whether used for arc or incandescent lighting, are intensely provocative of induction and noise, in telephone circuits; the character of the disturbance being much worse than that which is produced by lighting currents of constant direction; this latter sounding in the telephones like a protracted musical note of great volume. In speaking of the above it will be understood that the detrimental action upon telephones is the same when the dynamo current is used for motors as it is when used for lighting. Third: Certain classes of electric railways very seriously interfere with the operation of telephone lines, both in conversation, and also by establishing thereon a current which permanently excites the annunciator magnets The noises which are produced in telephones by dynamo currents induction are so well known that it would be waste of time to describe them.

When the troublesome currents are produced by electric light or motor circuits they may usually be attributed to induction, although a certain amount of absolute leakage doubtless also exists. Since, however, both causes produce in telephone circuits a like effect, it will be sufficient to speak of induction only. But if we consider the action of electric railways upon telephone lines, we find that the major part of the disturbance is due to the actual transference of a portion of the electricity which actuates the train motor to the telephone lines, by way of the rails, when these are used as return conductors, the crust of the earth itself, and the telephone line terminal ground wires.

As most of us know, the alternating current has received lately an increasing amount of the patronage of our light producing friends; and at the present time both constant direction, and alternating currents are largely used in electric lighting and power distribution circuits, the intensity of the disturbance varying with the class of current employed.

The violence of the induction, and therefore of the disturbance, depends upon the proximity and longitudinal distance of parallelism of the disturbing wires, the strength of the inducing current; the frequency or rate of change for the unit of the inducing currents; and the extent or range of such change; that which is due to wires carrying alternating current is, of course, much stronger than even the worst case of direct current induction; for even though the distance of exposure, and the strength of the inducing currents be identical, it is self-evident that a current which is completely reversed a great number of times per second must be much more energetic as a disturber of the peace than one which is constant in direction, and which varies only in strength on one side of the zero line.

These considerations indicate that our methods of prevention or cure should be directed at the stronger disturbing agency, since such a degree of success as we may be able to achieve against that will necessarily be equally effective as regards the weaker.

The proper way to cure or neutralize electric light or power induction is to prevent it. It is quite within the bounds of good construction so to relatively arrange light-

(*Continued on page* 149.)

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CONTENTS OF THIS NUMBER.

PAGE

NATIONAL TELEPHONE EXCHANGE CONVENTION.

Members and Guests 143
Treasurer's Report 143
Report of Executive Committee 143
Officers Elected 143
President Metzger's Acceptance 143
Notes on Telephone Batteries by F. A. Pickernell, and Discussion 143, 144, 145
Dynamo Current Interferences with Telephone Systems and Means of Relief, by C. E. McCluer, and Discussion. 145, 146, 147
The Electrical Relations of Telephone and Electric Light and Power Circuits and Railways, by Thomas D. Lockwood, and Discussion 147, 149, 150, 151
Editorial 148
Underground Work in Brooklyn, by W. D. Sargent, and Discussion 151
New York Subways, by Leonard F. Beckwith 151, 152
The Telephone Exchanges of New York City, by E. F. Sherwood, 152
The Telephone, by Dr. S. M. Plush. 152, 153
Social Features 153, 154
Exhibits 154

Electric Light Convention Echoes 154
The Salem, Mass., Electrical Road 154
Grand Opera House Incandescent Lights 154

The WESTERN ELECTRICIAN is the only paper which published a full report of the New York meeting of the National Electric Light association, and the only paper whose report is worth anything as a record of the proceedings of that meeting. No other paper gave more than one-half of the report, while the WESTERN ELECTRICIAN published it in full, and came out promptly as well.

For this piece of enterprise we are being amply repaid by many compliments and congratulations on the fullness, completeness and permanent value of our report, as compared with those of other journals. The telephone convention is taken care of this week in the same thorough and comprehensive manner.

THE recent disastrous storms have played havoc with wires of all kinds in a considerable portion of the country. They have been trying days to many companies, but it has been demonstrated that electricians are full of resources, and the rapidity with which the circuits were put in working order after such complete demoralization is almost marvelous.

The proceedings of the Electrical conventions can be happily contrasted with the deliberations of similar bodies in England. How much more practical and vigorous are the discussions of the American associations, and how much more beneficial are the results! The English papers have complained that too often in the British organizations members slyly urge the merits of the wares which they desire to put on the market. Nothing of this kind characterizes the American meetings. The remark of one of the members of the association who spoke of the interest which is manifested in England in the papers read before the convention is interesting and significant.

MR. PICKERNELL'S paper on batteries before the telephone convention was one of the greatest importance to all concerned in the practical work of a telephone exchange. It gave in a clear and concise way the results of practical tests, and it contained several suggestions which aroused considerable discussion.

NEW YORK'S telephone system is well described by Mr. Sherwood in his paper before the telephone convention. The recent controversy in this journal over the largest telephone exchange in the world, in which New York was given the supremacy by T. D. Lockwood, incites an additional interest in the paper, as it gives the statistics of the exchange in very complete form.

IN both the telephone and electric light conventions the discussions have been of a significant character. They were perhaps the most important features of the meetings, as Mr. Lockwood said in one of his apt little speeches. Members of these electrical conventions seem to be full of ideas on every subject presented. The abundance of ideas and fluency of expression are well worthy of remark; in fact, some of the remarks read like prepared papers.

THE general character of the make-up of the WESTERN ELECTRICIAN has been altered somewhat in the last and in the current issue. We have no apology to make; on the contrary, we have a feeling of pride in laying before our readers such full and complete reports of the proceedings of the two great representative bodies—the National Electric Light and the National Telephone Exchange associations. Next week we will resume our customary course, and devote more attention and more space to electrical news.

A VIGOROUS enunciation of a fact that is appreciated by every close calculator of costs in every large manufactory in the country was that of Mr. Morrison at the National Electric Light convention, when he said that experimental work will sink more money than the yellow fever will bury corpses in forty years. Very true indeed is this statement expressed in the inimitable way of the ex-president of the association, and it found exemplification in a subsequent remark by Mr. Sunny, who approximated the expense to the Chicago Arc Light & Power company of its experiments with cables at $50,000.

MR. SARGENT, in his paper before the telephone convention, gave a very interesting description of the present status of underground work in Brooklyn, N. Y. A supplementary paper on the underground work in Chicago is missing from the convention report this year, but it is to be hoped that it will appear next year.

This paper, rich with experience and abounding, in the mind of the thoughtful reader, with hints and suggestions, has a value to every telephone man in every city where underground circuits are about to be insisted upon by the public, or where the order has gone forth that the wires must go under the surface of streets.

IN another column is noted an accident to an electric street car in Pittsburgh. The conductor by his carelessness lost control of the car and it dashed down a hill. The item is printed simply as a matter of news; no particular significance is attached to it. The occurrence has been referred to as furnishing an argument against the electric system, but no such moral as this can be drawn from the accident. As long as careless men are employed accidents resulting from carelessness will occur. An accident of the kind is not more likely to occur with the electric system than with any other system. In New York, a few days ago, a car drawn by horses became demoralized on a grade. It dashed down a hill, and the lives of the passengers seemed to be held in imminent danger. Fortunately the track was clear until the car reached an up grade when it came to a standstill. Here are two cases almost parallel, and it seems fair to assume that the only lesson to be drawn from them is that the greatest care should be exercised by those in charge of street cars.

IN a recent report of the street commissioner of Jersey City, it was stated that 340 of the finest trees in the city had been killed, the greater number by gas leaking from the main. "The dead trees," it is stated, "stand along the line of the gas company's pipes. They will be removed. There is a talk among citizens of trying to get damages for the trees that have been killed by the gas."

There is nothing particularly novel in the statement. At one of the meetings of the West Side park commissioners in Chicago recently it was reported that many trees had been killed in the same way. Here is a strong argument in favor of electric light for the illumination of parks and streets. By all means keep gas out of the parks.

IN their papers relating to the causes which interfere with the satisfactory operation of the telegraph service, read before the telephone convention, Mr. McCluer and Mr. Lockwood differ somewhat in statement of the relative amount of trouble produced by induction and leakage. The former is inclined to believe that leakage is the great cause of the ills which the telephone is heir to. His statements are based upon his experience in Richmond, where the electric light wires and those conducting current for the electric railway produced an immense amount of trouble until Mr. McCluer found a plan for obviating the difficulties. Mr. Lockwood deals with both leakage and induction. He thinks that Mr. McCluer's views are a little pronounced. He thinks that both leakage and induction are both great causes of trouble and he does not think that the importance of the latter cause should be depreciated. The practical suggestions of Mr. Lockwood will commend themselves to every one interested in telephones. His advice to the officers of telephone companies to work harmoniously with the electric light companies, is a suggestion which has been lost sight of too frequently.

THE *Progressive Age* comments at length on the unjust criticism of electric light companies on account of the accidents which result from stupidity and carelessness. The journal mentions two cases, one in which a person left a gas-light burning in a room and another in which a person through foolishness received an electric shock. It continues: "Now both of these cases were due to the most gross carelessness, and it is not unlikely that if the two persons are ever placed so that the situations are reversed, each will go through the experience of the other—only they may not be so fortunate as to come out alive next time. The incomprehensible stupidity in either of these instances is on a par with that of the man who, having occasion to saw off a large limb of a tree that branched out high up from the ground, climbed up with his saw, seated himself astride of the limb and sawed it off between himself and the tree; of course he fell when the limb did, and was more or less broke up when he struck earth. The same man would be none the less likely to go to a hotel and blow out the gas, or tamper with electric wires, by reason of his experience with the tree. But we may not say because of his blundering mishap that it is dangerous to saw branches off trees. Of course, all possible precautions should and must be taken to make danger from electric wires as remote as possible, and the same is true of gas; but that to suggest that either shall be ostracised because an accident happens now and then from their use, is not reasonable. We venture to say now that ninety-nine out of every hundred accidents that happen are directly due to the carelessness of the person."

(*Continued from page* 147.)

ing and telephone circuits that no disturbance will result; and it is obviously much easier and less costly to construct them properly in the first place, than it is to change them. To secure this most desirable result, viz., the harmonious co existence of these widely differing classes of electric service, I wish to point out, that co-operation between the parties concerned is absolutely essential; together with a clear and full understanding of the conditions involved. Yet in too many instances, though, as I have stated, the telephone wires were already in the occupancy of the field, telephone companies have negligently omitted to watch their own interests with sufficient care, and have without remonstrance permitted electric light companies to erect wires close to their own, and of such a character as to render inductive disturbance a foregone conclusion. Would not a general good understanding between the different electrical interests of any city or town be desirable for the forestalling of such chances of future disagreement? In formal discussion, amicable conference and mutual consideration between the authorities of the several interests would tend to preclude any possible future misunderstanding, and would certainly act to prevent unnecessary antagonisms either between any of the several individual interests or with municipal authorities. A good understanding all round, is therefore suggested, as being an admirable forerunner to a system of non-conflicting construction.

Local managers of telephone companies should be instructed to report to headquarters at once, the intended construction of either electric light or railway circuits at any point within their territory, so that proper measures can be concerted, and adopted to meet the special conditions of the case.

If the general satisfactory understanding which I have outlined can be reached, it should not, I conceive, be difficult to bring intending electric light and railway officials to see that construction which is innocuous to their neighbors, and which in virtue of the provisions necessary to secure such innocuousness is thereby made safer in all respects, is, all things, considered, both cheaper and better than construction which is at any time liable to involve them in trouble, misunderstanding and damages.

The element of distance is of the highest importance. Telephones and electric light wires cannot be too far separated for the efficient working of the former, and the wires last strung should be run, if possible, on other streets from those in which wires are already in operation. In no case ought the two classes of circuits to be nearer together than the width of an average street. In writing the above I have not forgotten that it is oftentimes a matter of mutual convenience, that reciprocal privileges shall be allowed. This idea is by no means in conflict with the general principle that distance is the most efficient neutralizer.

The good feeling and understanding which I have advocated will be productive of a tendency to keep down unnecessary pole construction, and if either interest has a pole line through a certain territory, and if the other party has but a few wires going in that direction, it is doubtless often the best policy and practice to make the existing pole line available for both. By suitable agreement on this head both telephone and electric light systems are enabled to use each other's poles on occasion, and thus to carry a sporadic line, and accommodate a customer in districts which could not otherwise be reached, at least with due regard to economy. It is, of course, understood that an electric light company thus stringing wires on the poles of a telephone company must properly run its wires so as to produce a minimum disturbance; and that a telephone company taking its chance on electric light poles must not expect first-class results unless it be returned through the region of disturbance. The responsibility in the latter case is on the owner of the telephone wire alone.

If both sides of the street be fully occupied, and it should be really necessary to carry a main route of wires of both systems on the same side of any street, no other street being available, a state of affairs which ought not often to exist, it would, I should say, be better for them to be upon a single line of large poles than for each company to provide its own poles, and thus to incur the enmity of abutting property holders, municipal authorities and iconoclasts generally, for a uniform style of construction can then be adopted, and as the telephone current is the weaker the telephone poles should carry both sets of wires, and the construction should be supervised by its officials. This procedure is, however, only admissible if no other route can be found for the wires of that concern arriving last on the ground, and I repeat that whenever circumstances will permit, the width of an ordinary street at least should intervene between the wires of the two systems.

Electric light and power circuits ought always to be metallic; and in fact, every self respecting electric light circuit is metallic; this however being altogether without regard to its relations with contiguous circuits of other classes.

But a lighting or power circuit which is contiguous to telephone circuits must not only respect itself, but must respect the telephone circuits also, and hence must not only be a metallic circuit, but must have its two wires parallel, and as close together as possible, so as to be practically equidistant from the telephone wires, in order that the inductive effect exercised by the outgoing and incoming wires may be equal and opposite.

Where the distance of the width of the street is observed the parallel return wire frequently provides all the necessary neutralization, and prevents disturbances, for the neutralization is necessarily more perfectly effected, as the distance of the two wires of the electric light circuit from the telephone wires is increased; because the distance of the two wires of the lighting circuit from one another is a much less factor in a greater distance, such as the width of a street, and the two wires, therefore, operate much less independently than is the case when each wire is almost as near to a group of telephone wires as it is to its own mate. It is, however, often also found—and especially when the two sets of wires are on different horizontal planes of the same poles—that, even though the two wires of the lighting circuit be substantially equidistant from the telephone wires, perfect neutrality and noiselessness are not secured; and the degree of remaining disturbance is greater or less according to the distance between the wires of the two systems, and the distance that the said two sets run in parallel contiguity. The remaining disturbance manifests itself because the electric light circuit is not balanced. If, for example, one of the two sides of a lighting circuit be made to serve one or more lateral loops, while the other runs straight; or if one be connected with a greater number of lamps than the other, there is no balance; the electrical center of the main line does not coincide with the mechanical center, and one of the two wires exercises a much greater inductive influence than the other; the result being noise. By arranging the electric light circuit so that each side shall have an equal number of loops of like length, and an equal number of lamps or motors, and then by transposing or crossing the two wires of the lighting circuit about every fourth or fifth pole, the disturbance may be totally suppressed.

Such care in construction will most naturally be objected to, by electric light and similar companies, on the plea of expense, especially by such as have already constructed their lines in a style regardless of the rights of others; yet only by an insistence upon such conditions when the two systems of lines are in close proximity, can the business of telephone companies be protected. It may seem that these recommendations about the electric light and power circuits have very little to do with us, but my experience is that throughout the land electric light men have a very great deal of respect indeed, for the opinions of telephone men. In many cases where there has been noise and disturbance of the wires I have heard these electric light men say, "If you will show us what to do we will do it," and many have been perfectly willing to adopt any means to prevent disturbance if we will guarantee that when they have done what we recommend, it will stop the disturbance. It may also be objected that since the parallel return wire cross connected at intervals with the outgoing wire, is a remedy for inductive disturbances, it is one which should be applied by the telephone companies and to the telephone circuits as being the complaining party. But as to this, in addition to the already stated fact, that in nearly every case where the pernicious effect of induction is experienced, the telephone company was already in business and its wires in place; and that the disturbance originated with the advent of the electric light wires, and that common justice requires that the aggressor should apply the remedy, it may with reason be rejoined that the number of the electric light wires is much less than that of the disturbed telephone wires, and therefore the remedy may be applied to the former with much greater ease, and at much less expense.

We have considered the preventive or remedial measures which are applicable to this evil; and it seems clear that the right time for suggesting the propriety of observing these conditions of neutral construction is before the work has been done; and it is probable that the owners of disturbing wires will be much more willing to heed them, in originally arranging their wires, than where subsequent alteration is required; especially as in original construction, the plans suggested would not necessitate the numerous joints inseparable from later transpositions.

In any case, whether such remonstrance or suggestions as may be offered, tending to harmless construction be properly received and acted upon or not, it is our duty to offer them, and so to place ourselves in the right, and in this unmistakable position of having, at least, done our part in objecting to improper, and in stating our convictions of what constitutes, proper construction.

I have already alluded to electric railways, and to the fact that the weight of the evidence in regard to disturbances developed by them upon telephone lines tends to show that these are due not to induction, but to actual leakage of electricity from the railway conductors to the telephone lines.

There are several classes of electric railway: First, Those which utilize the rails for both outgoing and return conductors. Second, Those which employ a single overhead conductor, using the rails as a ground terminal or return. Third, Those in which the two main conductors are both in a conduit, to which access is had through a slit in the same way as a mechanical cable road is operated, trailing brushes or springs being led through the slit. Fourth, Railways which carry their own electrical energy in the form of secondary battery cells. Fifth, Railways which employ two overhead conductors—one as the outgoing and the other as the incoming line.

Of these plans, the first and second are very detrimental to the satisfactory operation of telephone lines; the fourth is perfectly harmless in all respects; and the third and fifth usually are also, and may be readily so made when they are not. All that is necessary to that end is to exercise such care in construction as to insure that the main conductors are properly insulated, and in the case of the fifth plan, that the main conductors are also prevented from coming into contact with overhanging branches of trees.

A great number of electric railways are built upon the second plan, and where they are run near telephone wires invariably exert a pernicious influence thereon, which is largely due to the imperfect return or earth terminals furnished by the rails; a portion of the current passing from them through the earth to the telephone circuits by way of the sub-station ground wires, thus occasioning interference with conversation, and affecting call signal apparatus, and often damaging property.

This class of construction is manifestly improper, both on the score of interference with the telephone wires and as being dangerous, and is of the cheap and reckless order.

When the remedies for its evils are so simple, and consist merely in adding a second overhead conductor, and in looking well after insulation, it would seem that they should be properly and universally applied by reason of the greater security they afford, even though those owning railways may have no just regard for the rights of others.

Telephone companies should therefore exert themselves and their influence in favor of the double overhead wire and other safe forms of railway, the former being, in fact, safer in other respects and more economical in operation than railways which in any way utilize the rails as conductors.

When other systems are already in use, and should it be found impossible or impracticable to persuade the railway company to provide a return wire, and where the telephone service is consequently impaired, the only absolute remedy is that of providing the telephone circuits which are affected, with a parallel return wire.

The disturbances may, however, be greatly softened down or subdued by carrying the ground end of the subscriber's wire from his office or house to some point at a considerable distance at one side or the other of the railway, and by there terminating it instead of at the sub station itself. Considerable success has also been attained in practice in the amelioration of this trouble by connecting the leading outwires of a number of neighboring disturbed telephone lines with a large common return wire grounded at or near the central station, instead of grounding each in the ordinary way.

If the leak is so great as to affect the annunciators, it is sometimes requisite that the common return wire, instead of being grounded, shall be connected with the several central office terminals of its group of lines, exactly in the same way that its outer end is united to the outer ends of the individual lines; that is, of course, when these are at rest. By adopting this plan the earth connection is, when the lines are not in operation, completely cut off If the disturbance does not affect the talking, ground connections can be provided for use during talking. If it does, then the return must be retained during talking also.

Though this paper is already long, there are still one or two points on which I should touch. In one of the children's hymns composed by the late lamented Dr. Watts, occur these lines:

"One sickly sheep affects the flock,
And poisons all the rest."

And upon the principle thus enunciated, it not infrequently happens that, though but few telephone wires, or even a single wire, be exposed to disturbance originating in and by the causes recited, the trouble is propagated to others by induction by reason of the close massing of a large number of wires at or in the vicinity of central stations.

Consequently, one wire adversely affected by electric light or railway disturbance may influence deleteriously many others. The lessons we have to learn from this are, that if we have one wire so affected, we ought, in some way, to promptly attack the evil in that wire, remedying the trouble while it is small and controllable; and that it is essentially our duty to remove dead or unused wires at once, unless there is good reason to anticipate an early resumption of use; and even then they should be disconnected from the two terminal stations; and when I say disconnected, I don't mean simply short circuited, or cut out, but absolutely detached, dead wire being one of the most prolific and active agencies of disturbance and danger. True, it costs something to take down wire, and it may be troublesome to put them up again when required, but it is the only safe proceeding, and in such matters the anchor ought to be cast windward every time. It is better to spend a few cents in defense than it is to spend possible millions on account of the misdoings of a dead wire in tribute.

Finally, if the number of disturbed wires be smaller than that of those causing the disturbance, or if it be necessary to run a telephone wire through a region of disturbance, the simplest, easiest and most economical way is not to monkey with the buzz saw, but at once to make the telephone circuit metallic, at least through the region of disturbance, which operation should, moreover, invariably be performed in cases where less drastic measures fail.

MR LOCKWOOD: Now, one word as to Mr. McCluer's device. It is true, as I said before, that the evil he has had to encounter is actual leakage from the rails, and that it has manifested itself both by affecting the coil apparatus and by affecting the conversation, and there was no reason, even before he tried his device, to doubt that it would do its work. I do not know whether it has totally eliminated the noise, but if it softened it down fifty per cent., as he says—if it has made it bearable so that people can talk, a great deal has been done There have been, since the beginning of the telephone business, I think, some six hundred patents issued for different forms of telephone, and I think, perhaps from three to four thousand patents for telephone appliances, out of which perhaps two hundred have directly or indirectly referred to systems or arrangements or pieces of apparatus for reducing, eliminating or neutralizing induction. A great many are not worth the paper they are written on. But this device of a return circuit, I think, probably, was first indicated by the old way in which those of us who were telegraph men used to run what we called combination locals. We used to have a number or combination of local battery cells, one for each sounder, and we would bring them all back over a common wire. A little later, when the telephone business began, quite a number of persons—myself among others—patented a system in which a common return wire was provided, or a group of circuits. That was in 1880. In the application for a patent that I put in we had a narrow escape from an interference with some of Mr. Scribner's applications for patents which afterward went into force throughout Indiana, Ohio and Illinois as the Wiley-Scribner telephone exchange system. I know Mr. Durant remembered it because he has been in interference with him. Since then the very idea of using a common return as an induction neutralizer has been patented by a man named Bentley, and within the last six months the American Bell Telephone company bought that patent with a lot of others, and the American Bell Telephone company buys patents so that its licensees can use them. I have not made these observations with the idea of belittleing Mr. McCluer's invention, because there is not the slightest doubt that he invented it independently and for his own work, but simply to say that none of the rest of you, if you wish to use it, need hesi-

tate for fear of trenching on his prerogatives, because it is open to every one of you who are licensees of the Bell Telephone company.

MR. DURANT: I would say that we have for three years used that device, and have it in use now. I think it is applied on twenty-four wires. It came into use from the interference of the Heisler incandescent system, which uses an alternating current Presuming, of course, that the Heisler circuits were constructed in conformity with the rules of the board of public improvements, namely, in close parallel lines, we did not examine them, and we put this common return wire in use, and we found it very effective In the meantime we found that Mr. Heisler had one side of his circuit on the side of this street where this particular run of wires was, and the other on the other side. We made him correct that I was surprised to hear Mr. McCluer say it was novel

MR. BAILEY: I would say in relation to the troubles from electrical railways that our experience coincides in almost every particular with that of Mr. McCluer, and further that we have found that the gentlemen who are at the head of these railways are willing to do what they can when they are told how to do it. The trouble principally has been that enterprises of this kind are organized and foisted upon a lot of gentlemen who heretofore have not been in the business. The lines are built usually by construction companies that are sent out generally from New York city. These gentlemen, as I said before, who own and put their money into these companies, know nothing about the requirements of their own business, but they take everything in good faith. It is the interest of the construction company to get through with the work and get the money and get out of town as soon as possible. The only course of safety for the telephone companies is eternal vigilance during the process of construction, in raising objection to anything they may find is deleterious to their service. The only railways with which I am familiar are those having a single overhead conductor with a rail return, and with them it is necessary to preserve a uniform elevation above the center of the roadway. In preserving that elevation it is almost impossible for them to construct the lines in such a manner as not to interfere with the telephone circuits. Their ordinary height, I believe, is regulated at sixteen feet above the center of the roadway, and it is necessary to put up poles on each side of the street about twenty feet in height; in practice they put them up a good deal higher in order to carry the suspension wires high enough. In the operation of the railway trolleys running along on their conductor wire have the effect of breaking their insulation, and in the course of a little time, no matter how well they may have attempted to insulate their wires the insulation becomes very defective, and the current leaks from the suspension wires and guy wires. Therefore, a line of poles set on each side of the street and charged in the manner in which they are charged is very dangerous to telephone wires or any other wires of the kind coming into contact with them. Of course that is only a matter of mechanical construction. I should think they might be insulated so as to prevent absolute crosses. We note the same result of leakage from the earth to our telephone wires as we have from the grounds of an electric light circuit. You take an ordinary electric light circuit with one ground and you find no difficulty no damage; but the minute you get two you get trouble. We have frequently found trouble from electric light circuits which, when traced, were located in electric light circuits being in contact with gas fixtures so as to turn into our exchanges currents that would throw down one or two hundred drops at a flash. We complained of one of the street railways in Scranton and at last threatened to take legal proceedings to obtain relief, and sent to New York for some experts. Among others Mr. Prescott, a prominent electrician here, came to Scranton and examined the system, and said it was a matter of induction entirely, and it was folly to suppose that an electric current would leak from the earth to any other conductor. After it once got to the earth it was dissipated. Of course the opinions of those gentlemen are worth considering. At the same time the trouble continues. Then the company improved their insulation and removed the trouble from a good many of our lines. In some lines they are affected still so badly as to hold the annunciators to the coils, and of course the talking service on them is very poor. We adopted the general return wire Mr. McCluer speaks of on some of our lines, and found it gave us absolute relief. We have not adopted it generally; but in following that method I cannot see any objection to using a return ground and having it connected with the general ground of the exchange. But if that general ground, if led off to some other point had not returned parallel with the wires that are served, I do not think we would have got relief. We tried it in Scranton We got a little relief, but very little. It is very certain that a current from those electric railways will set up currents not only in parallel telephone lines, but in lines that reach the line of their railway by a different route altogether.

THE PRESIDENT: Does the chair understand you to say that it is not material whether the ground wire returns to the central office or whether you run it off in another direction?

MR. BAILEY: It is very necessary; but I say the railway affects some lines which take a different route to reach it.

MR. GIFFORD: You do not believe it absolutely necessary that they should run the general current parallel with the telephone lines?

MR. BAILEY: I think the general current should return on the same line of poles as the lines that are served and as near the center of the line as possible. I think you get better results than you would if you hung it below or above.

MR. GIFFORD: You said that this return of ground wires, to obtain the best results, should be parallel with the lines of overhead wire and then be connected with the central office ground wire.

MR. BAILEY: We connect it to the central office ground.

MR. GIFFORD: We have twenty different routes in different portions of the city. Is it practicable to connect all those returns coming from different portions?

MR. BAILEY: So long as you do not overload your ground wire above its capacity. You can start out, as Mr. McCluer says, with a heavy wire, and as you have less wires to serve use a lighter wire.

MR. DURANT: I think you misunderstood Mr. McCluer as to the location of the ground. He said it was immaterial whether it was in the central office or at some point remote from the center of this disturbance.

MR. BAILEY: I think it is immaterial, although the general ground should return on the same route with the wires that are served on that ground, and as nearly equidistant as you can place it from the wires that are served. There is another point I want to call attention to—that is, the matter of danger of dead wires in relation to lighting trouble. We have had a little of it in our country. Of course, we have a system that covers a good deal of country, and is made up largely of country lines, and in the changes in telephone business, dead wires occur with us as they do with every one else, and dead wires are sometimes a good deal more costly than living ones. The usual course of proceeding, when a telephone is discontinued, is to take the telephone out without making any provision for the wires; the wires are left standing. The question is, during a thunderstorm what will become of a current that may gather on that wire without any connection to the earth. It certainly has to discharge somewhere, and in discharging it is likely to do a good deal of damage. It strikes me that it is similar to the case of a defective lightning rod which has no earth connection. We have a case of that kind where a loop was taken out on one of our lines. The line got charged from a thunderstorm and the lightning followed in on those open wires and struck a child and knocked her insensible. She recovered without any apparent damage; but it was a thing that it strikes me should be guarded against. Wires of that kind should be removed from the premises.

PROF. VAN DER WEYDE: I am in a position to state certain results in regard to that general return wire which I obtained in a series of experiments some years ago, made with the purpose of economizing the wires with a double metallic circuit, and having one general return wire. I found that if a general return wire substituted for a ground wire is not close to the direct wire, it is of no use. I found that it is only reliable when the wires are all connected together as much as possible in a cable. If they are some distance one from the other when one direct wire is nearer to an electric light wire or the return wire is nearer to the electric light wire than the other, we will have inductive influences. Therefore I adopted the system of making a well insulated return wire of low resistance in the center. I found that to be a very reliable method of obliterating the disturbing effects not only of direct electric light currents, but also alternating currents; but it cannot be insisted upon too much that the return wire and the direct wire should be as close as possible together.

MR SEELEY: In New York city in 1885 we put up a Patterson cable. In those days they made a cable with a large center core. I think it was a number 6 wire. We connected to that cable some 500 subscribers, and grounded the central core in the central office. While the cable worked fairly well and cut down the induction, cross talk and leakage, we discovered by ringing up a subscriber on a long wire that we would also ring up a subscriber on a short wire, and that with two wires of the same comparative resistance, if two subscribers attempted to talk at the same time, the cross talk would be very severe. We immediately abandoned the scheme and considered it useless.

I would also like to state while I am here before the convention that I presume in New York city we have a larger number of electric light wires in the air than any other city in the world. All systems are represented here. It is the policy of the Metropolitan company to grant pole privileges to those companies. We have a blank form on which they make application to the company, and by granting them permission to erect their wires on the property of the Metropolitan company we are in a position to dictate to them; we tell them exactly how we desire their wires to be constructed; how many lamps on each circuit; whether we should divide the lamps in positive and negative sets. The East River Electric Light company have about 2,200 or 2,500 attachments on our poles, and their wires are built in the most excellent manner. We are suffering very little from the leakage from their currents They use the Thomson-Houston system, and are giving us no trouble whatever.

MR THORNBURY: It seems to me that providing this return wire is providing a method almost as expensive as it would be to the electric light company if they returned their wire, which in equity and justice they should do. It does not seem to me that the telephone companies should establish a precedent which the electric light companies may force them to follow afterward. It is not anything but right that they should put their systems in such a condition as not to interfere with your service. If you are on the ground first you have vested rights If you go into a district where they have built before you they have vested rights, and you should then provide means to equalize the induction on your wires or substitute some method on theirs; that is, give them wire to lengthen out their circuit, and return them in the proper manner. The return wire method, as Mr. Seeley has pointed out, has its defects, and the greatest defect it has is that the current on one circuit will divide itself and go back on the other if the return wire is not of infinite resistance. Mr Seeley tells me he has used a return wire also; but number 4 copper and number 6 copper is the wire ordinarily used for electric lighting, and for that length of line, if the electric light company run on one street and return on another, Mr. Farnham had better have given the electric light company the necessary wire to return their circuit on the same street, it seems to me. I think the convention ought to take some action in convention with the National Electric Light association. I was almost ready to make a proposal that this association appoint a committee who might meet a committee from the National Electric Light association to discuss the matter of providing methods and means whereby we might harmonize the interests of the two companies.

MR LOCKWOOD: No one, of course, has any doubt that any remedy proposed, which is in itself a half-way measure, can fail to have some disadvantages. I do not think Mr. McCluer proposed to use fifty lines, but only one return wire Besides that, the return wire was not, as I understand it, proposed for electric light circuits so much as it was for electric railways, and for instances where it is impossible to get the electric light and electric railway people to do their work properly. If there are but three or four lines or five or six lines provided with a common return, and if that common return is made large enough and of sufficiently low resistance and properly constructed there will be no trouble with back lash It becomes in that case more like the average hotel annunciator circuit, in which three or four lines may be connected with a single bell and a single return.

Mr. Balley spoke about dead wires. I wish once more to point out that almost the concluding paragraph of my paper emphasized that very point, that dead wires are one of the greatest sources of danger that we have to contend with, and as soon as we get an unused wire it is our duty to take it down, unless there is an immediate prospect of a resumption of business It is not only our duty, but it ought to be our pleasure, because it certainly does away with one source of danger and disturbance

With reference to the suggestion offered by Mr. Thornbury, that it would be a happy thing for a committee of this association to confer with the National Electric Light association, I do not think any gentleman here could listen to such a proposition seriously discussed. We cannot deal with an association in these matters. We must deal with individual companies and individuals themselves.

MR. MCCLUER: If the members of the association will allow me I would like to occupy a few moments of their time in making a little plainer, probably, than I did in my paper one or two points that have been brought up since the discussion began. In the first place, with reference to the metallic circuit and the common return wire: As a matter of course I have known for years that the metallic circuits and common return wires have been in use. I did not suppose that I was originating anything new in devising a simple metallic circuit or a simple return wire. But I do believe that I did devise something new when I devised what I call a compound metallic circuit a metallic circuit with one wire only to serve the purpose of a return wire, with an unlimited number of wires attached to it I also believe that I have devised a new idea in substituting a metallic conductor in place of the earth without any earth conduction at all I am perfectly familiar with Mr. Bentley's and Mr. Marbury's patents They are both for anti-induction cables, and to apply these systems to telephone exchange plants would necessitate the entire reconstruction of the plants. The system that I propose to use does not require anything of the kind; not a solitary wire on poles or house top fixtures has to be changed or altered in any way. All that has to be done is to put up one additional wire for every wire, whether the number is one or two, or a dozen or hundreds, on the same route, and the only change that has to be made in the system is the simple substitution of this common return wire for the ground. To prove that, I will state that I have in the Richmond Telephone exchange to-day eighty seven stations connected to a single return conductor. That conductor starts from the central office with a No. 4 covered copper wire extended to a distance of half a mile from the central office. Connected to that is half a mile of No. 6 covered copper wire, and continuing the wire a mile from the office—beyond that it is my intention to use a No. 8 copper wire to reach the various stations of the subscribers. I have now one such wire only in use in Richmond, extending from my central office up Ninth street to Broad, and thence out Broad to the terminus. On that wire I have eighty-seven stations connected just exactly as they were before to the earth, and by means of the plug switch, which I have in the central office, I can use that common return wire either as a general ground wire, making all these subscribers' wires take earth at the central office or, by removing this plug, I can disconnect them entirely from earth and use them as metallic circuits. Of course I could not conceive it possible that no one had tried this arrangement before. It was only after making the experiment I did that I induced our officers to allow me to make this practical test. When I made my first practical test and connected my first ten or twenty stations on the first half mile of copper wire, I was exceedingly interested in what the result would be. The very next night after it was done I went to the central office I spent nearly two hours, from 10 to 12 o'clock, with four or five of my inspectors going to different stations that we could get into on this line, and all of them talking over the different circuits at the same time, all of them ringing over different circuits, and doing it all simultaneously; there was no interference.

You could not hear on the call wire or on any of the wires a word that was uttered on any of the others. I then went on, as I say, when I got the additional number 6 wire from our company and extended my circuit out to the western extremity of the city. I wanted a number 8 wire to connect on to the number 6 and number 4 in order to reach my stations lying off on the cross lines. Our company thought, however, that a smaller wire would answer the purpose, and they furnished me a number 14 copper wire. I used the number 14 copper wire and to-day we are using eighty seven stations, the wire being used, of course, during the business hours of the day as a general ground wire, without any interference whatever.

Mr. Lockwood says he did not understand me to say that it was my intention or expectation to connect any considerable number of wires to the same line. I do propose to do that. I propose to have only one wire of large conductivity on every line of poles. It does not matter whether the pole carries twenty-five wires or two hundred and fifty wires. In telephone practice we use a single wire and very often a number 8 or number 9 iron wire for a ground wire, for half a dozen or a dozen different circuits

for carrying currents of greater electromotive force, of course, than we put on our telephone wires.

PROF. VAN DER WEYDE: I wish to state that according to my experiments it is possible only for twenty or thirty operators on a telephone line to communicate with one single return wire. My experiments were made five years ago in anticipation of the necessity of putting the wires underground. I found that with return wire I had as many as twenty or thirty different wires between which communication could be had and that the call could be rung without mutual interference. Then I got, by the kindness of the telephone company, the use of a number of cables containing some hundred wires and a central wire. They called it the Patterson wire. But the results were unfavorable for the reason that this cable was connected at both ends with the ground.

MR. RILEY: About three years ago we had occasion to run a common return ground, such as Mr. McCluer described, to overcome the induction from the Delany synchronous telegraph on a line parallel with ours for about five miles. We ran number 12 copper wire for about four miles and connected it to six stations, and almost entirely overcame the noises from the telegraph wire and suffered no interference whatever from ringing from one station to another, and had no interference from cross talk. That line is still in use and giving satisfaction.

The secretary read Mr Sargent's paper as follows:

UNDERGROUND WORK IN BROOKLYN.

BY W. D. SARGENT.

The extension of underground conduits in Brooklyn has been restricted since my last observations on the subject to short sections for the purpose of connecting our new buildings in the Brooklyn and Williamsburgh districts with the underground system. All of the new conduits have been made of creosoted wood, the ducts three inches square, inside measure, with the exception of one short section of Macdonald creosoted wood with round holes two and a half inches in diameter. It is fully decided, however, that hereafter no ducts will be laid with an opening of less than three inches in the clear.

In order to make ample room for the conduits reaching to our principal office, 16 Smith street, we have built a tunnel the whole width of the street, high enough and wide enough to walk through, and it now carries 108 ducts with room for perhaps 60 or 100 more. There are special features in this tunnel and method of bringing the terminals of the cables into the building which it is difficult to describe or to reproduce in a drawing.

The first sections of our creosoted wooden conduits have now been in service four years. There is no evidence of decay and the ducts remain clean and dry, enabling us to draw in, and withdraw the cables without any difficulty.

So far as conduits are concerned we think experience has fully sustained our judgment in favor of the creosoted wood.

One of the most important things after the conduits in underground work, is the manholes, which should be as large and commodious as possible. Within reasonable limits it is almost impossible to get these manholes or working chambers too large. While from the start we realized the importance of this part of the work, we have in quite a number of instances been compelled to rebuild and enlarge the manholes as first designed. Given a conduit of durable material, connecting with commodious manholes, this part of the underground problem, so far, presents no serious difficulty.

The character of the cables to be drawn into the ducts and the method of distributing wires from them, are questions that demand our most earnest attention.

Experience has taught us that larger conductors and thicker insulation, together with twisted metallic circuits, are an essential part of perfect service. Conductors of .035 to .040 of an inch in diameter, insulated to .125 of an inch in diameter and twisted in pairs, with 100 to 104 wires, or 50 or 52 metallic circuits, make up a cable of from two to two and one-fourth inches in diameter. Such a cable will weigh between four and four and one-half pounds per foot, according to the amount of lead, and on account of the tendency of the lead pipe to buckle in bending, we do not believe that it is practicable to handle cables of larger diameter and weight. The consideration of these facts led us to decide that our ducts should hereafter be three inches.

We are using nothing but the lead covered types of cable, some of which has been in service underground for four years and is still in good condition. Of the cables which were laid four years ago those covered with pure lead appear to be more than half eaten through. One that had been drawn out during the writing of this article has been underground for two years and is badly corroded, there being holes eaten in it in many places nearly one-sixteenth of an inch in depth. Of the cables furnished by the Western Electric company at the same time, in which there is a small percentage of tin mixed with lead, the corrosion is very slight, and we are led to believe that cables covered with this alloy will last from three to four times as long as those covered with pure lead. We believe that if in addition to the tin the cables were drawn through a bath of gas tar or asphaltum, then covered with a good stout braid and run through the gas tar or asphaltum again, the cables would be practically imperishable, so far as the outside covering is concerned, and it is a question whether this additional expense would not be justified by their increased length of life. It is certainly worth the trial.

The air tight terminals which were put on all our lead cables more than a year ago appear to have removed all the difficulties which we formerly had at that point, and the tests of our cables, making due allowance for temperature, etc., show that there is no deterioration during the past year.

Of the cables mentioned by me last year, one of 7,180 feet, containing 100 wires, twisted indiscriminately, manufactured by the Western Electric company, has been reduced by the change to the new central office to 6,344 feet. Tests made Aug. 16, 1888, give the insulation 800 megohms, capacity .22 microfarads, resistance of the conductors 43½ ohms per mile. The conductors are .038 of an inch in diameter, insulated to .088 of an inch. For a time during the past year all the conductors were in service, but recently the trunk lines to Bedford office have been taken out, and there are now 80 wires working through it. The condition of this cable in regard to cross talk is the same as last year. That is, it is not bad enough to prevent its use.

The cable manufactured by the New York and New Jersey Telephone company, with 100 wires, twisted in pairs, has been reduced to 6,117 feet. Tests Aug 19, 1888, give the insulation 89 megohms per mile, capacity .275 microfarads and resistance of the conductors 48 ohms per mile, temperature in both these cases being, in the air, 80 degrees, and of the water from the hydrants, 73 degrees. We assume that the temperature of the water from the hydrants is the temperature of the air in the conduits. Seventy-four wires are working through this cable, and the cross talk is no worse than last year and is not so bad as to prevent its constant use. In both cases all the dead wires are kept grounded at the cable terminals.

The greatest length of cable we have now underground is 11,800 feet, between our Bedford and Williamsburgh offices, consisting of 100 wires, twisted in pairs, the pairs broken up at all the splices, conductors .035, insulated to .075. The insulation of this cable is 99 megohms per mile, capacity .26 microfarads, resistance of the conductors 47 ohms per mile. Seventeen conductors in this cable are in use for trunk service between the two offices, the rest of the wires being grounded close to the terminals at both ends. The cross talk in this cable is very slight and is indeed less than in the Western Electric cable of 7,000 feet. We received complaints from both these offices that the talking by subscribers through this cable was difficult and unsatisfactory. A special investigation of these complaints at the points they originated, demonstrates that the difficulties complained of are not in the cable, but rather in the condition of the transmitters and instruments in the various offices and carelessness of the subscriber. Considering this cable as a whole, two miles in length its electrical qualities are, insulation 50 megohms, capacity 52 microfarads, resistance of conductors 94 ohms. We are inclined to think this is about the limit of good working in that type of cable and that the complaints that we are getting about the service over it are due to the fact that it loads up the circuit so that there is no margin for any deficiency in the subscribers' circuits connected to it; whereas if its efficiency was higher there would be a margin to cover such defects, and complaints would be prevented. There is no doubt that the reduction of the cross talk and the increase in the capacity is due to the fact that 83 of the 100 wires are grounded at the terminals, and that when the whole cable is put into service this condition of affairs will be changed more or less; that is, the capacity will diminish, and the cross talk will increase.

It was a consideration of the difficulties to be encountered in the use of greater lengths of this type of cable, which the above experience emphasizes, that decided us during the past year to make a special cable for our trunk lines, doubling the weight of copper and thickness of insulation. This resulted in our ordering three miles of cable, conductors .032 of an inch in diameter, insulated to .125 of an inch, 60 wires laid up indiscriminately, and during the past two months, two miles of this cable, or 10,560 feet, have been put up on the elevated railroad structure, connecting the Brooklyn central office with the Bedford central office. The insulation is between 1,200 and 1,500 megohms per mile, capacity .27 microfarads, resistance of conductors between 21 and 22 ohms per mile, at a temperature of 74 degrees. This cable though of the same length as the one between the Bedford and Williamsburgh offices, just mentioned, gives surprisingly better results, the cross talk being very slight and the volume of sound full and strong. Forty of these wires are grounded at the cable terminals and 20 are in active service.

There does not seem to be anything in the electrical measurements to indicate what causes the difference in the practical workings of the two cables, but the results are gratifying and seem to plainly indicate that increasing the weight of the copper and thickness of the insulation is a step in the right direction, and I am inclined to think that grounded trunk wires of this last type may work successfully between our various Brooklyn offices, the distances between which do not exceed two and one-half miles.

All the new cables we have used this year have been of 102 wires, or 51 pairs, twisted, laid up in regular cable form, in alternate reverse directions, conductors .035 of an inch in diameter, and insulated to .125 of an inch. The insulation of these cables when placed in position underground ranges from 1,500 to 2,000 megohms, capacity from .17 to .18 microfarads, and the resistance 52 ohms per mile. We believe that this type of cable will fulfill all the conditions required in our underground work, but at the present time we have no length sufficient to give actual working results.

The transition period between grounded and metallic circuit systems will be very troublesome and annoying and may last several years. It is our intention in ordering the type of cable just described to make provision in the manholes for joining the sections together by devices which will enable the joints to be opened readily without cutting the cable, and the pairs broken up in order to prevent cross talk on grounded circuits; and, at the same time, allow of access to them for straightening them through when twisted metallic circuits are required. The necessity for getting at the joints in this way from time to time and the space required to accommodate connecting boxes is another argument in favor of large and commodious manholes.

The durability of lead pipe, with a slight mixture of tin, the maintenance of a uniform and high insulation, together with uniform resistance of conductors, after four years of service, are indications of length of life that are very encouraging.

Up to the present time we have met with no serious accident in our underground work, either from explosions of gas or the men being overcome with foul air. We believe it quite likely that gas is not as plentiful in the streets of Brooklyn as it is in many other cities, and therefore the accumulation in the ducts and manholes is not so great; but we have been very careful not to spare any precautions that would insure our safety.

The Dorsett conduit, of which we have five miles, with ducts two inches in diameter, has proved to be very unsatisfactory, and the ducts, on account of inequalities at the joints, will only permit of a cable an inch and a quarter in diameter being drawn in. This reduces the capacity enormously, and is, therefore, a source of inconvenience to us.

It is plainly proved that the use of underground wires reduces the margin of good working very largely and will therefore require that extraordinary care must be taken to bring the service to its highest efficiency at all other points.

The most fruitful source of our trouble is the transmitter and battery, and while there have been very great improvements during the past year or two, there is still room for much more improvement before we reach perfection. The numerous contacts, in the magneto bells and other apparatus need especial attention and care, and platinum should be used wherever possible.

Another source of trouble is carelessness in running the wire from the insulator outside the building to the instruments in the building. The writer knows of many cases where the subscriber's wire is run through a window casing with the ordinary cotton covered wire and but little care taken in the inside of the building to keep it away from possible dampness.

As the mileage of underground wire increases, these and other faults, now overlooked, will become more and more apparent and the expense of maintenance and inspection will be largely increased. There is only one way to bring back the easy working margin we have enjoyed on pole wires, and that is by the use of metallic circuits, and the sooner we get down to that basis, the better it will be for the service.

The following shows the actual extent of our underground work on Sept. 1, 1888: Length of conduit, 15.17 miles; length of duct, 105.5 miles; length of cable, 22.93 miles; length of conductor, 2053.3 miles; 1,913 subscribers are working through underground wires using 1,229.9 miles of wire.

MR. BECKWITH then presented the following paper:

THE NEW YORK SUBWAYS.

BY LEONARD F. BECKWITH.

In the following statement I have recorded a few data relating to the construction of electrical subways in the city of New York, which may be of interest: The work was commenced in the latter part of 1886, and has been carried on since with but slight interruption each year during the season favorable to out-of-door operations. The subways as laid out and built have been authorized and approved from time to time by the Board of Electrical Control, and the Consolidated Telegraph & Electrical Subway company has been directed by the board to construct them under its contract with the latter. The execution of the work has been intrusted by the above company to its sub-contractor the Phoenix Construction company, which has charge of all subway construction in this city. The subways have been designed and laid out to meet the main requirements of the chief connecting or trunk lines of the various electrical companies so far as they could be ascertained, and so far as they could be conveniently grouped together. The principle of keeping the high tension electric currents for arc lighting and power in subways on one side of each street, and the low tension electric currents for telephone, telegraph and other purposes in subways on the opposite side of the street, has been laid down, and so far adhered to. The question of distribution from the conduits has been wisely left by the Board of Electrical Control to the various electrical companies to express their preference for the method best suited to their special systems. This the companies have been repeatedly invited to do, and while some have responded, and their methods of distribution having been approved as reasonable and feasible they have been accommodated as rapidly as possible, other companies have held aloof and refrained from action, apparently wasting precious time and neglecting to occupy and secure their commercial field and districts.

The subways built, except the Edison, are all on the "drawing in" system which provides a group of tubes or ducts extending from one manhole to another, admitting of the drawing in and out of the electrical cables, and affording convenient access from the street. Different systems of grouping the ducts in the trench, and different materials have been employed, consideration being held of the importance of the line, the question of cost, the durability, tightness against water and gas, etc. Experience has shown us that a main conduit consisting of separate pipes which can be crowded or curved or kept apart is the best adapted to overcome the numerous obstructions met with underground, and frequently diminishes the trenching necessary. Screw jointed asphalted wrought iron pipe laid preferably in hydraulic cement concrete presents the greatest tightness of duct against gas and water united with the greatest strength. The cement pipe and creosoted wood tubes present also features of great merit and adaptability. A special feature of New York subway difficulties is the steam heating underground system, of which the leaks in certain localities greatly interfere with the ducts and cables, precluding the use in such places of materials of construction softening or melting at about 160° to 200° F. In the case of long telephone lines, the desirability of comparing non-metallic and metallic ducts in respect to their influence on low tension currents, has also been kept in view. A continuous line of telephone and telegraph subway is now completed about seven miles long, and the above comparison can be made on five to six miles of this length.

The endeavor has been to provide a subway construction

that will be most durable and that will give the best mechanical protection to the cables against injury from settling of the ground, heat, water, gases, etc., etc. The solution of the electrical question of underground working is one that relates to the manufacture of suitably insulated cables, and belongs properly within the province of the electrical companies.

The work accomplished up to September, 1888, is shown in the accompanying tables:

Dorsett ducts coal tar concrete	235,837	feet
Zinc tubes laid in hydraulic cement concrete	68,883	"
Creosoted wood tubes	167,175	"
Cement pipe laid in hydraulic cement concrete	216,626	"
Iron pipe laid in asphaltic concrete	131,284	"
Iron pipe laid in hydraulic cement concrete	1,423,722	"
Iron distributing pipe	23,301	"
Edison iron tubes	222,794	"
Grand total length of single duct	2,489,602	feet
Grand total length of single duct	472	miles
Grand total length of trench	37	miles
Number of manholes	523	
Total length telephone and telegraph ducts	376	miles
Total length electric light ducts	96	miles
Length of telephone and telegraph trenches	10½	miles
Length of special electric light trenches	17½	miles

Besides the above there is still about three-quarters of a million feet of single duct for telephone, telegraph and electric light purposes authorized by the Board of Electrical Control, that remains to be constructed, besides contemplated lines.

The standard size adopted for telephone ducts is 2½ inches clear inside diameter, corresponding to a capacity of 100 wires or 50 conductors in metallic circuit grouped in a lead covered cable. The chief portion of electric light ducts other than Edison ducts are 3 inches clear inside diameter.

The manholes are all of brick laid in cement mortar with 8 to 12-inch walls and concrete bottoms. They vary greatly in form, and are from 8 feet by 12 feet to 4 feet by 4 feet 6 inches in size, and from 6 to 12 feet deep. The street casting used has a double cover; the inner cover and rubber gasket are held down by a wrought iron cross bar, a bolt, and padlock. The covers are practically tight against water.

The systems of distribution in use are as follows:

For telegraph purposes, an iron pipe from a manhole connects underground with a building or with the foot of a pole.

For telephone purposes the above method is used, and also in connection therewith a pipe running up the face of a building to the roof where from a fixture the cable is divided for distribution on the block and surrounding blocks. Sometimes the pipe is carried up through an elevator or ventilating shaft. In addition to the above in the down town district and along Broadway to Union Square an iron 3-inch pipe is laid in the trench above the subway, and provided at intervals of about 50 feet with malleable iron circular distributing or service boxes with screw covers 12 inches in diameter, with side outlets through which a cable can be conducted by a service pipe into the buildings.

For electric light distribution the Edison company have their special system laid. The Johnstone cast iron distributing conduit with 6 ducts and flush boxes has been authorized to be laid in Broadway from 14th street to 35th street for purposes of electric light distribution, and will provide all the necessary facilities for this district.

Up to August 27, 1888, there were 3,567 miles of wire laid in the subways by the Metropolitan Telephone & Telegraph company. This company has laid a 100 wire lead covered Patterson cable from Whitehall street to 58th street, a distance of about six miles; this cable is believed to be the longest of this size in existence underground. The Western Union company have about 100 miles of wire underground, and the Edison company about 126 miles. The Brush Electric Illuminating company are putting an 8-conductor Standard cable in the Broadway conduit from 14th street to 35th street, a distance of one mile, making 8 miles of electric arc light wires.

Other applications for space in the subways and for the construction of additional electric light lines are pending.

THE PRESIDENT: The next paper to be read is entitled, "Telephone exchanges of New York city," by E. F. Sherwood.

THE TELEPHONE EXCHANGES OF NEW YORK CITY.

BY E. F. SHERWOOD.

The Metropolitan Telephone & Telegraph company has 7,300 subscribers, operated by eleven exchanges, which are furnished with the following systems: John, 39th, and Harlem exchanges Western Electric multiple; Pearl, New, Nassau, Murray and 21st street exchanges, Chinnock system; Spring street, improved Chinnock system, adapted by Jos. P Davis, formerly general manager of the company; Fulton and Beaver street exchanges, Law system

The John street exchange has 799 subscribers and 40 trunks, distributed among them; 39th street exchange has 1,108 subscribers and 39 trunks, and Harlem has 374 subscribers but no trunks terminating outside of the trunk sections The reason that we have trunks at the two former exchanges among the subscribers, is to connect the system with points not accessible or convenient to reach with trunk calling wires.

To operate the boards during the busiest hours requires the following number of operators: John street, 14 operators, 57 subscribers per operator; 39th street, 21 operators, 52 subscribers per operator; Harlem, 6 operators, 62 subscribers per operator, but counting the trunk wires according to the business done over the average subscriber's wire will be equal to adding 73 subscribers to John street, and 70 to 39th street, thus increasing the average at John to 62 and at 39th to 56 The reason we have a greater average at John and Harlem is, that they are situated in the center of a business district, while 39th street being a manufacturing and residence district a larger portion of the business is trunk.

We are using what we term trunk calling wires between the various exchanges, one terminating at John street and the other at 39th street, for calling all trunk connections to the exchanges named.

There is an average of 3,000 connections per day called over each of these wires, and as each connection is ordered off again the number of orders is increased to 6,000. All of this work is done by two operators at each of these exchanges and could be done by one if a whole section of the board was within her reach We divide the trunks, one-half being used for receiving and the other half for sending. Those we receive on are not multiple through the board but end in cords and stand open at all times except when in use. When a number is called on any given trunk the connection is immediately made and is ready for ringing, this being done by the office calling, as we make the office where the call originates responsible for the connection. If the number called is busy we throw the battery on the trunk dropping the annunciator as a signal. We find this system very advantageous as there is no delay in calling or clearing trunk connections, and the service is made prompt as shown by ten trunk connections made and conversations started with subscribers in six and one-half minutes

At the exchanges which have the Chinnock system each operator at the cases answers 100 subscribers and completes all local connections, using a local calling wire and a set of local trunks which connect all the cases. The calls for trunk connections are written on slips of paper and passed to the operators who control the trunks to the various exchanges. Ten trunk connections were made, and conversations started through this system in twelve and one half minutes.

The Fulton and Beaver street exchanges have, together, 410 subscribers and are operated by nine operators and one chief operator. All local connections are completed by the operator who receives the call over the calling wire, and trunk connections are completed by the operator at the exchange for which the subscriber calls The Law operator simply connects the subscriber's wire with the trunk wire, and rings down the annunciator, when the operator answers and ascertains from the subscriber the number wanted. The trunk connections made through the Law system were completed and conversations started in four and one quarter minutes, ten local connections in two and three-quarter minutes.

The number of trunk wires connecting the exchanges in New York city is 532 and average 60 connections per day, and as this average could be increased to 70 per day, the number of subscribers could be increased 600 without increasing the trunk facilities. To other exchanges we have 187 trunks, and with these the service is quite satisfactory, especially so with the new Brooklyn exchange of the New York and New Jersey Telephone company, as the service is prompt and satisfactory in every particular.

By the consolidation of the seven exchanges in the new exchange at 18 Cortlandt street, 206 trunks which connect these exchanges will be abolished and the number of trunks to all other exchanges may be reduced, for the total number divided among the seven exchanges will not be required when they are all accessible to an operator in the new exchange

The new switchboard at 18 Cortlandt street, will soon be completed and the consolidation of the seven exchanges made. It is wired for 5,100 subscribers and 900 trunk wires. The subscribers' operators will attend to 50 or 75 wires according to the business done at different sections of the board. Trunk calling circuits to the other exchanges will be in operation, each receiving trunk operator attending to 50 wires. The local battery of each operator's outfit will be two cells of storage battery, one to be in use during the day and the other at night. The one in use during the day will be charged at night from the main storage battery and the night battery will be charged from a dynamo during the day. All wires will approach the exchange through the underground system, the underground cables terminating in the cellar. From there they will be carried to the distributing board in the exchange by 334 conductor cables

The consolidation of the several exchanges will be beneficial in many respects The service will be improved, the great volume of "sent" trunk business will be reduced from 20,000 to 8,000 connections, and the running expenses of the exchanges will be reduced about $2,700 per month.

One thousand, five hundred and twenty-seven miles of wires are now underground and 2,784 separate wires are altogether or in part so working, most of which give general satisfaction. The underground facilities are rapidly increasing, 18 miles of 102 conductor cable running from 18 Cortlandt street to various points are now completed and will be used when the exchanges are consolidated. Eight and three-quarter miles of the same cable will soon be run for trunks from 18 Cortlandt street to the other exchanges, thereby making the trunk service from this exchange entirely underground and doing away with the delays and expense of crossed and broken trunks, and will do away with the danger of crosses with wires carrying a heavy current which proved so costly in connection with the burning of the 39th street exchange, on which a few remarks may be of interest.

On May 23d the 39th street exchange was set on fire by a cross with a wire carrying a heavy current and one and one-half sections of the board were burned out. The work of restoring the Western Electric multiple board after it has been burned and saturated with water can only be appreciated by those who have had it to do. In order to straighten out the wires it was necessary to make 1,260,000 tests, to splice 9,600 broken wires, to replace 16 cables which were destroyed from the switch board to the cupola, and dry out the saturated portion of the board. The work of getting the lines in complete working order was delayed by the accumulation of line trouble while the troublemen were working in the exchange, but the switch board and all the lines were in complete order two weeks from the date of the fire.

MR. DURANT: We have a system in use between St. Louis and East St. Louis which I think is novel. If you are familiar with the Law system, as I presume you are, you know that we use two kinds of call wire, the one metallic and the other an open circuit. East St. Louis, while it is in the state of Illinois and on the opposite side of the river, has a relation to St. Louis commercially that is very important. The railroads all terminate there, and the business between St. Louis and East St. Louis, telephonic and otherwise, is very great. The exchange at East St. Louis consists of only fifty subscribers, and about 90 per cent of the traffic of that exchange is with St. Louis. Ordinarily, in the Law system, the trunk line business is done over two receiving wires, one from exchange A and exchange B and the other from exchange B and exchange A, and we have that same arrangement between St. Louis and East St. Louis. However, the ordinary method is for the receiving operator to throw a telephone and transmitter into the sending call wire and give an order, expressed by numbers to the receiving operator. In the case of East St. Louis, which is occupied by an open circuit call wire which runs to the operator at the central office at East St Louis, that line is extended to the receiving operator at East St. Louis; it is not grounded at East St. Louis. Consequently the order for traffic at East St. Louis is heard by both operators—by the one at East St Louis, and also by the one at St. Louis. The direction of the traffic is indicated by numbers. The numbering series at St. Louis commences at 100 and runs up to 5,000, while the numbering at East St Louis is confined to the 5,000 series. When the subscriber at East St. Louis gives his order, of course the direction of the connection is expressed in the way given That order is overheard by the operator at St. Louis, and without any word between them they select the lowest number idle trunk line, and the connection is made without any word passing between them. If any of you can beat that on the trunk line service we would like to know it.

MR. SEELEY: We are using call wire precisely as Mr. Durant describes, with the exception of the St. Louis circuit. The operator who could formerly handle only seven trunk wires is at the present time handling fifty trunk wires. Instead of sending and receiving trunk wires she virtually becomes a switchman at number 1 exchange, while the operators at number 2 exchange are simply calling into her from the call wire. I presume the company is saving $10,000 or $12,000 a year in salaries on the trunk line system alone.

The secretary read the following paper by Dr. Plush:

THE TELEPHONE.

BY DR. S. M PLUSH.

No discovery or invention was ever born at a time when the world was more ready to receive it than that of the telephone; notwithstanding which, great talent, perseverance and wealth were necessary to its successful introduction. The uncertainty which unfortunately hedged it about gave rise to temporary work and machinery, which has simply been renewed to the present time, and to day the vast telephone system of the country is but a network of unreliability and temporary make-shift. Even the head centers or main exchanges, with but few exceptions, representing untold labor and the expenditure of large sums of money in machinery and apparatus, are held by but a feeble tenure. At that period but little time was given for consideration, and a forecast of what the future would be was difficult. The growth of the telephone plants was without a parallel in any industry; the demands made upon them were greater than their means of supply; competent labor was not in the market, and efficient machinery had not been devised. The difficulty of meeting the requirements of a large number of subscribers at a given point early presented itself, and gave rise to a number of small exchanges, even in the most populous districts. This, together with the resistance on the part of the public authorities to the erection of necessary conductors, set the seal of fixity upon what is manifestly a great hindrance to good and reliable service, while in nowise conducing to economy. The expense for rents, light, fuel, trunk lines, and the introduction of so many additional connections into circuits, call loudly for aggregation, and we believe the tendency is in this direction, and the time not remote when trunk lines will be known only as a means of reaching points far distant.

Probably the greatest drawback to-day to the complete development of our telephone systems is a growing tendency in legislative bodies to regulate prices to be charged for service, which, in effect, is simply to paralyze its growth and efficiency.

Were the telephone the only means of communication some regulation might be wise. Such, however, is not the case. We have the postal, telegraph and messenger service, each filling its own peculiar sphere as regards reliability, speed and cheapness. The telephone should, so far as practicable, combine all of these features, but neither should be sacrificed to the others; to regulate either must be at the expense of the whole. When the field is once open to competition that company which rigidly adheres to reliability and promptness in its service, will not suffer through paucity of its finances.

Nothing in my opinion has operated more to the disadvantage of both the telephone companies and their subscribers than cheap rates. Many, through this means, have been induced to become subscribers to an exchange who have no real need for the facilities it affords. This lends a tone to their business, it is true, and serves in a measure as a card of respectability. Their place at once assumes an imaginary importance, and if there is any one thing that delights them more than another, it is having some real or fancied business with a leading and substantial firm This they manage to have at frequent intervals, thus taking the time and monopolizing the wires of others, to their detriment and absolute loss. Important business is thus delayed, and the value of the exchange materially lessened

Busy houses to-day find it necessary to have some one

in constant attendaoce at the telephoae, and yet many calls are so delayed as to be useless. It is but fair, therefore, that their interests should have as many safeguards thrown around them as possible, that their convenience and time may not be engrossed by frivolous questions, in which they bave no interest whatever. In other words, an exchange may be so large as to be comparatively worthless.

Constant effort toward speed, both of connection and disconnection, is being made, thus making a greater number of calls in a given time possible, and thereby removing the limit, which would otherwise soon be reached; but this limit must ultimately be reached, and what then? Even now requests for discrimination in making connections are not uncommon

At the present growth of our largest exchanges the time must come when a more select means of communication will be demanded by the business public; that is, an exchange for business—select if we may so term it—where a party to become a subscriber will not only be required to pay his annual rental for service, but must hold a certificate of membership as well. George Eliot remarks that we begin life, knowing little and believing much; a few years of experience, however, and in many cases the quantities are inverted. This aptly applies to every man connected with electrical science and mechanics, particularly the telephone and its environments.

We live to-day in the same atmosphere we did ten years ago; nothing has materially changed except ourselves, and we only in credulity. True, our experience has been great and varied and has taught us in some instances how not to do, and by this slow but certain method of evolution may in time teach us how to do.

It is difficult for us to realize that we are gradually making a history, and that the records of the great telephone must eventually be written; that we are each of us contributors thereto; that no matter how small a factor each may be, he is a part, and that at last his individual size must be determined by the magnitude of the whole.

It behooves us, therefore, to see that the foundations of the telephone, which are now being laid, shall be solid and firm; that every right, every franchise, shall be permanent; every structure substantial, every centering point immovable, and every method correct, and to this end the energies and intelligence of those associated with the telephone can be profitably directed.

THE PRESIDENT: Are there any remarks on this paper?

MR. DURANT: I do not believe there is a class of men in the world who appreciate the telephone less than the men engaged in the business. The reading of the paper called to mind a statement made to me by the manager of one of the largest and best papers in the country, published at St. Louis. He told me that on the night of the earthquake, which occurred about 12 or 1 o'clock at night, inside of two hours he called up 103 stations in various parts of the city, and got two columns of very interesting matter, showing the effect of the shock in various parts of the city. That will, perhaps, show its value in one direction.

The capacity of an operator under great stress was decided in our exchange, I think, last January, under the direction of Mr. Doolittle, and if any of you have not made that test I would suggest to you to make it, to show the number of connections that can be made in a given time by a single operator. On this test fifty-three were made in five minutes.

Invitations were extended the association by the Erie Telephone & Telegraph company and the Northwestern Telephone Exchange company to hold the next convention in Minneapolis, Minn., and by the Michigan Telephone company, in Detroit.

By vote Minneapolis was selected.

MR. ECKERT on behalf of the Metropolitan Telephone company extended an invitation to the members and delegates to visit the new building of the company and see its big switch-board.

MR. KERR: The question of taxation by the boroughs, by the cities, by the townships and by the state, has caused the Pennsylvania Telephone company a good deal of trouble. I believe the law in Pennsylvania is in a mixed up condition, and it is probable that members of the convention here could throw some light upon the subject which would assist us in determining what course we ought to pursue. The Pennsylvania law, I believe, as to the taxation authorized by boroughs is that boroughs can only tax after the analogy of the taxation by the county commissioners. The act signed by the governor of Pennsylvania on the 24th or the 25th of May, 1887, gave the cities of seven classes the right to tax telegraph telephone, electric light and power companies; that is to charge a license tax. There are, however, decisions by the Pennsylvania courts which show perfectly distinctly that the plant of a corporation cannot be taxed. Notable among these is the Coatesville company's decision which is constantly cited by the Western Union and by other companies interested in the matter. It was there decided that plant was capital and could not be taxed. Now, almost every city and borough in which our company is interested is trained to tax and is trained to institute a pole tax. The Western Union Telegraph company has recently secured a decision of the Supreme court of the United States that a pole tax is illegal. I believe that is on the principle that the line is an inter-state line and business an inter-state business. However, there is another principle on which the Western Union Telegraph company is now standing that the boroughs and cities have a right to tax and to charge this license tax only on a police principle, and this license tax cannot be a tax per pole but must be a tax on the telegraph property in proportion to the value which the telegraph property bears to the other property taxed on the police principle in the city. This has reduced the Baltimore & Ohio Telegraph company's tax in one city, I am told by J. B. Stewart, superintendent of that company in Baltimore, to the sum of thirty nine cents, whereas the effort to tax was something like a dollar a pole. If any company represented in the convention can name any principle which governs other states or which is established by the law of other states, which would form a precedent, as Pennsylvania law is undecided, it would be very useful. If any person, also, has seen a decision of the Supreme court of the United States which is to the effect that the tax must be a tax on the police principle and in proportion to the value that telephone or telegraph property bears to other city property it would be very useful, because the establishment of such a principle by the Supreme court of the United States would render it impossible for any city or borough to tax at so much per pole, and as the cities and boroughs are trained to tax at so much per pole it would be a very important thing for telephone companies to know whether we could not on some legal basis established by the Supreme court of the United States contest that effort of the boroughs.

The only other question I have to ask is that if there be any such principle established by the Supreme court of the United States, whether there be within the knowledge of gentlemen present any principle established by the Supreme courts of other States which could form a precedent towards establishing the law in Pennsylvania.

MR. GIFFORD: The matter has never been brought before the courts of the state of Kentucky. I suppose there are always some persons in every legislature who from motives of patriotism or some other "ism" like to put a heavy tax on corporations. But we appeared before the committee on law and taxation in the Kentucky legislature and stated our case to them, and they decided to levy a State tax in this way: One-fourth of one per cent. upon our gross receipts in lieu of all other state taxes. While that is a little more than the average rate that other people have to pay on their property we deemed it policy to consent to it, and it is the law. In the state of Kentucky machinery in operation is not taxed, and our assessors have considered that our central office system, our bells, telephone and transmitters come under the head of machinery and they are not taxed. I have been in the habit of going to the assessor and asking him what he thought the thing was worth provided the patent was removed. I would say, "What would you give for those wires and poles around here?" He would say so many thousand dollars, and he taxed it that way, and we paid as we would on any other personal property at that rate. We also have a very reasonable business license. We are perfectly satisfied with it. It is about two and a half times what the average license is. The city license in the city of Louisville is based upon one dollar upon a thousand. At that rate our tax would be $125 or $150. They have assessed a license tax of $250 a year. We thought it would not pay to quarrel with the municipal authorities for $125, and we acquiesced in that. We anticipate no trouble from the tax question there; but nothing of the kind has ever been brought before the courts.

MR. DURANT: I presumed that every possible question that could arise under the various laws authorizing taxation has been raised in the state of Missouri and passed upon, and as a rule all those things go to the Supreme court. We pay a tax upon our personal property the same as any other cities in the state. In addition to that the city of St. Louis is authorized by its charter to impose a license tax upon sundry callings, and it was a question whether they had that right to impose it on a telephone company. We concluded that it was very much better than a tax upon our poles, and when the matter was under consideration we concluded we preferred that. The result was that we pay an annual tax upon our gross receipts; it amounts to a considerable sum, and after 1890 it doubles.

MR. BAILEY: Do I understand the gentlemen to say that he pays a tax on his gross receipts to the city government as well as the state?

MR. DURANT: No; we pay the tax on our gross receipts to the state. We pay the tax on our personal property—it would be to the county, but as a matter of fact the city of St. Louis is an independent locality by itself; it is not in any county. There is a county of St. Louis and a city of St. Louis, but they are independent organizations. The city of St. Louis used to be in the county of St. Louis, but by its special charter adopted some twelve years ago, it is independent of the county. We pay the tax on personal property to the collector of taxes. We pay the tax on the gross receipts within the confines of St. Louis city to the city treasury.

MR DRAKE: There are very simple matters in vogue in Iowa and Nebraska of taxation. In Nebraska the companies report their property direct to the state auditor. The statements are laid before the board of equalization. They assess the property and then assign to each county its proportion. The county authorities then collect the municipal and state taxes. In Iowa the state board of equalization fixes the assessments upon statements from the companies and levies the tax direct. The tax is paid to the state treasurer, and that is in lieu of all other taxes of every description No other city or county authorities have any right to levy any tax on any telephone or telegraph property.

MR. DURANT: Are you quite sure that any city in Nebraska has a right to license?

MR DRAKE: In Nebraska they have a right to levy an occupation tax: that is a special prerogative bestowed upon municipalties; it is a tax upon the business, not upon the property.

MR. DURANT: Are those occupations specified in the charter of the city of Omaha?

MR. DRAKE: Yes, sir

MR DURANT: And the telephone and telegraph companies are omitted from the list?

MR. DRAKE: No; they are included in Nebraska You, as an individual, may own a good piece of property on which you pay a special state and county tax. On that piece of property you are conducting a business. They will issue you a license to do a business in the town.

MR. DURANT: Why cannot they license you to do a telephone business in the city of Omaha?

MR. DRAKE: They do not in the city of Omaha, but they do in many of the towns and cities.

MR. DURANT: Then, that license tax is in addition to the personal property tax?

MR. DRAKE: Yes

MR. MAILEY: I would like our president to give us some light on the tax question as to the states of Pennsylvania and Ohio.

MR. METZGER: It seems to me that the tax question is a political one, and I cannot see how or in what way this association can affect the method or mode of taxation. In Pennsylvania, of course, we are taxed upon our gross receipts, and also upon the dividends. I think the tax is eight-tenths of one per cent. on our gross receipts and then three mills upon every one per cent. of our dividends based upon our capital stock. In the smaller towns of Pennsylvania we are not taxed for poles. In the city of Pittsburgh proper we are taxed for business purposes. That is all the tax that we pay for business purposes, and, of course, we are taxed at the same rate as all other classes of business based upon the amount of sales or receipts. But there is no tax on poles, or wires, or telephones. In the state of Ohio they tax us on the poles. There they have a property tax. The tax is on the value of the plant, and they have sought, of late years, to tax us on the telephones. We have resisted this so far successfully, and we are taxed precisely the same as all other citizens are taxed. We think that we are entitled to pay our taxes just the same as the citizen who own a house and lot, or in fact any other corporation.

In the state of Ohio we have no state tax. Of course, we exist there by comity between the states under the rule that a corporation chartered in one state may transact business in another rtate. We have another town in the western part of the state, called Newcastle. A member of the council there did not pay his bill, and we brought him up with a round turn and compelled him to pay his bill. In the tax ordinance he moved that the telephone companies pay $250 as a license tax. The electric light companies were taxed $125; the natural gas companies were taxed $125, and so on, depending upon the character of the business We told the council plainly that we would resist the payment of that tax; that they had no right to discriminate; that if they taxed us the same as they taxed all other companies on the same volume of business, that we would pay; that we are not going to pay $250, when the natural gas companies whose revenues were ten times greater than ours, paid only $125. What the result of that case will be, I don't know, but I am inclined to believe that the council will modify the action in that regard and tax us the same as they taxed the other companies. At least, if they do not, we shall resist it by all legal means that we have at our command.

THE CHAIRMAN: I take it that Mr. Kerr wanted to get information as to the valuation of the telephone property as a basis for taxation as much as anything else. It might be interesting to get views of members from various parts of the country on that. In my experience I have had struggles with various assessors over their extravagant ideas of the values of poles and wires.

MR. GIFFORD: If that is the subject, I would say that we make our returns based on the original cost of the plant, and from that we deduct ten per cent. annually for depreciation. We make that return under oath, because we believe that is a fair statement of the actual value of the plant.

MR. BAILEY: I would inquire if in making those returns the president includes his corporation appliances or merely what we might term personal property and buildings. There was a law in Pennsylvania that a corporation was free from local taxation, and was only subject to the general taxation law of the state. In Pennsylvania, I think, the great bulk of the entire state government was carried on by taxation of corporations. Railroad and other corporations, gas companies and water companies, have fought that all the way through, and uniformly with success About a year ago there was, as Mr. Kerr says, a law passed allowing cities to tax telephones and telephone companies at a certain rate. We have never made any resistance to what they attempted to do. The generality of cities have levied what they call a police tax—a police franchise, and rather than bring up the question, we have paid it cheerfully. Some of the smaller towns have attempted the same thing. So far I have been able to throw them off the track by going and seeing the council—generally the council's attorneys, and arguing the question with them with the uniform results of having them withdraw all the claims. There is one case that I have in mind that by agreement between our attorneys, was settled by a case stated; that is a question of law to be heard before a judge of the court of common pleas; that has not come up yet.

MR. METZGER: I would say, in regard to Mr. Bailey's remark, that there was an act passed in 1887, authorizing the creation of cities of the fourth, fifth, sixth and seventh class. That act gave express authority to councils to levy a tax on telephone companies in the language of the act. It is under the act that these councils are acting They do not fix any rate, however; they leave it optional with the city council as to what it shall be.

The secretary's statistics were ordered printed, instead of being read, and the convention adjourned.

SOCIAL FEATURES.

Any doubts as to the hospitality of New York must have been removed by the experience of the attendants at the meetings of the railroad telegraph superintendents, the National Electric Light, and the National Telephone Exchange association, all of which have been held in the Empire City this season. The weather on all these occasions has been perfect.

Commencing with Tuesday night, the visiting telephonists were entertained by their indulgent parent, the American Bell Telephone company at Niblo's Garden, where they witnessed "Matthias Sandorf," which was appropriately followed up by a lunch at the Electric club. The business session of Wednesday was arranged to allow for sufficient time in the afternoon for the visitors to dine quietly at the Brunswick. At the completion of the dinner,

they found six tally-ho coaches and several barouches for the overflow awaiting their pleasure. This was the welcome of the American Telephone & Telegraph company, whose officers desired to show them the blizzard-proof pole lines recently erected in upper New York under the intelligent supervision of the veteran constructor, Fairbanks. During the drive up Fifth avenue to and through Riverside Park, an opportunity was offered for the delegates to visit the tomb of General Grant. They then walked across the park to Claremont Hotel whence the coaches conveyed them to 155th street, where the new pole lines were inspected, and which, it is needless to say, elicited the warmest praise. Returning down St. Nicholas avenue, and through 7th avenue to Central Park, the gentlemen were transferred to the guardianship of the Western Electric company, represented by Messrs. C. A. Brown, H. B. Thayer and W. R Patterson who had gained possession of the Mount St. Vincent Hotel, and cornered all the good things in that popular house for the benefit of their guests. Many local friends joined the party at this point, and the large dining room was comfortably filled with a jovial party of about 175. It was past 9 o'clock, when a murmuring cry of "Thayer" pervaded the assemblage, which gradually swelled in volume until finally that gentleman arose, and amidst a tumult which drowned all speech, managed to inform his enthusiastic friends that Mr Dutton had been appointed toastmaster for the occasion. That gentleman had made elaborate preparations to call out everybody, and announced that everybody wanted to speak, but there was not time The first toast, "The American Bell Telephone company" was responded to by Mr. French, who stated that he could only voice the regrets of the executive officers of the parent company.

Mr. Tyler, of New Haven, in response to "The Telephone," thought that it was like conveying coals to Newcastle to spring a toast of that character on a gathering of telephonists. He had been invited to respond to the sentiment of "Eastern Licensees," and had accordingly gone out on the back stoop and prepared his speech. If he had been asked to respond for the subscribers, he could have found plenty to say in their behalf. Although he believed the parent company had made some mistakes, he believed the business of the local companies was stable to-day, and valuable property, because of the skill and the energy, and the confidence in the justice of their cause, with which the great patent contest had been waged

G. F. Durant was called upon to represent the licensees, and made a strong argument in behalf of the policy of the parent company. His remarks were received with great applause.

C. J. Glidden responded in behalf of the north and southwest, and Thomas D. Lockwood was asked to explain the effect of the telephone on what Mr. Storke understood to be the "Vassar motor nerve." It required considerable ingenuity to work out the case, and there was so much cross talk that even a telephone voice could scarcely penetrate the expanse of the great room, but Mr. Lockwood availed himself of the opportunity to pay a handsome tribute to Mr. Berliner as the inventor of the battery transmitter and the application of the induction coil to telephony. If he had done nothing more, added Mr. Lockwood, that was an enviable record.

A. F. Sefton secretary of the Conduit company, was asked to speak of the underground systems of the past, but excused himself by claiming that he had to do only with the subways of the present and future. He gave way to the Hon. Daniel L. Gibbens, of the Board of Electrical Control, who said that it gave him great pleasure to be present and partake of the bountiful entertainment tendered by the Western Electric company, and congratulate them all upon the success of the telephone enterprise He said that the underground law of New York was really beneficial to telephone interests, as the time had arrived when it was hardly possible to extend their service by reason of the number of wires in the streets and over housetops. Where 200 wires had been in use it was now possible to accommodate four or five times that number. He congratulated himself that his official position had brought him in contact with such an admirable body of men, among whom were many with whom he could work in harmony.

Treasurer Storke, as guardian of the boodle, and the telephonic "Poobah" was called upon to respond for the Telephone Association.

J. C. De Groot, of Antwerp, congratulated them upon the unity of interest in this country.

W. A. Hovey responded for the "Press," and President Henry Metzger expressed the heartfelt thanks of the association for the generous manner in which they had been entertained while in the city.

C. A. Brown, of the Western Electric company, responding for the host, felt extremely gratified that they should all be so well pleased. He had flattered himself that his troubles were at an end. He regretted the absence of President Barton, whose wonderful foresight had done so much to further the interests of the telephone business. The impatient coachman sounded the bugle during Mr. Brown's remarks, and admonished all who heard it that the hour waxed late.

A. S. Hibbard started up "Auld Lang Syne" and the coaches were rapidly filled, and the banqueters went to their various quarters to rest.

Thursday morning, at 11 o'clock, 250 of the telephonists left the West Twenty-third street ferry for a sail in the "Cygnus" on the Hudson, at the invitation of the Metropolitan Telephone and Telegraph company. The invitation included the sail, a dinner at the Casino, St. George, Staten Island, and the performance of "Nero."

The beauties of the Hudson are well known, and were fully appreciated by the excursionists. A very hearty welcome was tendered by Mr. Eckert on behalf of the company, and with music and dancing the boat went gaily up the river, past Spuyten Duyvel, Yonkers, Hastings and Tarrytown, up to Croton Point. On the Tappen Zee the boat turned, just giving the party a distant view of Haverstraw. A lunch was partaken of, and after a most enjoyable trip the "Cygnus" called at Twenty-third street wharf, and then went on to Staten Island, where the visitors sat down to a sumptuous dinner, closing a very pleasant day witnessing the gorgeous display which Kiralfy had provided there.

EXHIBITS.

The Okonite company, of 13 Park Row, New York, had their usual fine display of okonite insulated wires and cables for underground and submarine use, and okonite tape in all its varied applications.

C. McIntire & Co., 36 Crawford street, Newark, showed samples of their well known joints, weather-proof and impervious to moisture.

The Metropolitan Phonograph company showed a graphaphone, which attracted considerable attention.

The New York Insulated Wire company had a full line of samples of Grimshaw's patent white core wires.

The Western Electric company had an effective show, including their long distance telephone, with connections to all parts of the city; Hussey battery, cable switch board wires, cable terminals, Germain battery and magneto bells. Their pretty paper weights, made from sections of Patterson cable will be kept by many of the visitors as mementos of the convention.

The Standard Underground Cable company had an excellent display of their specialties in lead covered wires and cables The new Acheson electric light cable terminal evoked much interest. It is used for connecting the cable with the pole line of the lamps, or as a testing station between sections of cable. It appears to be an absolute protection from disruptive discharges in the cable.

The Law Telephone company, 112 Liberty street, New York, showed the improved Law prism battery for telephone, medical and general use

The Union Indurated Fiber company, 37 Barclay street, New York, exhibited samples of their fiberite, which is specially fitted for battery jars, and their specialty, the indurated fiber pipe, which has many excellent qualities.

H. B. Cox Electric company, of New Haven, Conn., exhibited the gelatine battery.

The Bridgeport Brass company, Bridgeport, Conn. displayed their stress tables, which show the stress in pounds on a span of their hard drawn copper wire for any given dip from two to thirty inches when in a state of rest, and for spans of varying length.

The National Conduit Manufacturing company, 18 Cortlandt street, New York, showed conduit samples.

The Electrical Accumulator company, 44 Broadway, New York was also represented.

The Electric Gas Lighting company, 35 Arch street, Boston, Mass., showed their Samson battery.

The Phœnix Glass company of New York was also represented by an exhibit.

Electric Light Covention Echoes

The delegation of the members of the National Electric Light association, after a delightful sail from Providence down Narragansett bay, reached Newport Sunday morning, September 2d, and here again the admirable character of all the arrangements made for the trip by General C. H. Barney and the members of the committee, was exemplified. The electricians who had hoped to be able to accept the invitation of Commander Higgins to inspect the training ship New Hampshire, but unfortunately were unable to do so, made their way to the beach, and braced their appetites by a dip in the sea. At two o'clock they dined at the Ocean house. Carriages were then provided through the courtesy of the Newport Telephone exchange, and the party was taken by Mr. Bull and the officers of the Edison Illuminating and Newport Incandescent companies along the celebrated ocean drive, and a most charming excursion was had. The electricians had been invited by Commodore Goodrich to visit the United States naval torpedo station on Goat Island, and at 5 o'clock the launch Wave was at the wharf to carry them across the bay. No more interesting time was spent during the whole trip than the two hours of their stay on Goat Island. Submarine warfare is destined to exercise a powerful influence on the future of nations, and our own government, fully alive to the importance of recent developments, has fitted up the station with very complete apparatus for tests and experiments, including steam generators, engines, dynamos, and an electrical laboratory, to which heavy currents are conveyed by underground conductors. Every year a course of some months is taken by naval officers in torpedo work, diving, electricity, high speed engines and the chemistry of explosives, and seamen are instructed in every department of modern naval war practice. The electricians were conducted to the laboratory, and here the great value of recent experiments was made strikingly apparent by Prof. Charles G. Munroe, who, in a clear and masterly way, explained the purpose and effects of tests which determine the force of gun cotton and detonators, and the character of fracture in different metals. The professor also stated that at this station is made all the gun cotton used in the United States navy. After inspecting the other departments the visitors repaired to the dynamo room, from which they had an opportunity of witnessing an excellent exhibition of the capabilities of the search light which threw its powerful rays across the bay and illumined the venerable Catskill that was waiting to take them to the end of their journey. Every one left the island feeling that the time had been profitably and entertainingly spent; the courtesy and attention of Lieut.-Commander G. A. Converse, Lieutenants Rohrer, Holman and Hutchins and Prof. Munroe were highly appreciated.

The steam launch Wave is the smallest craft afloat carrying a dynamo. It is a Parsons turbo-electric generator, making 9,000 revolutions a minute, and is of 40 lamp power at 70 volts.

The Catskill left Newport soon after eight, and arrived at New York on Monday morning.

The Salem, Mass., Electrical Road.

During the past month a number of electrical railroads have been put in operation by the Sprague company, and among them is the Naumkeag street railroad at Salem, Mass. The number of electric cars upon this road are six. They are all running smoothly and well, and it is said that the company intends to extend the line to Beverly with an increased electrical equipment.

The cost of operating these cars by electricity is 40 per cent. of the cost of operating the same number by horses. The length of the line is a mile and three-fourths. Altogether, there have been set 175 wooden and 14 iron poles. The length of wire used is nine miles, including contact, main, feed, ground and span wire. The length of line, that is, main wire, contact, ground and feed wire, is seven miles.

The cars are fitted with lightning arresters, as are all the cars which have been equipped by the Sprague company.

The cars make regular fifteen minute trips to the willows, at the terminus of the road, and have carried heavy freights. One car recently took 110 passengers easily up over the steep grade at Fort Lee, a long hill which has frequently compelled even three horses to succumb.

For winter work, clearing snow and ice, the Sprague company has what it terms its "working car." This car is fully equipped with plow, ice-cutter, sand and salt distributors, and is driven by a powerful 40 horse power motor. In front of the car is a revolving wheel which breaks up the snow crust, and behind it a revolving brush which sweeps the rails clean. In Carbondale, Pa., the car has worked with entire success. In Richmond, there were two or three bad sleet storms last winter, but by putting a man on top of the car and knocking the contact wire with a short pole, the ice was easily cleared from it.

To obviate the noise from the motors the company is attaching a wood fiber substance to the gearings, making them absolutely noiseless. This fiber, by a peculiar process, though it is composed entirely of wood, is rendered as hard as steel.

Grand Opera House Incandescent Lights.

The managers of the Grand Opera House in Chicago have discarded gas for the illumination of the theater, and hereafter incandescent lights will be used. Those who attended this place of amusement immediately after the installation were able to appreciate one of the great advantages of electric light—that it does not add to the heat. The temperature during the last days of August was high enough without any addition from several hundred gas burners. There are 850 lamps in the theater. Current is supplied from the Edison central station. The lights in the boxes, chandeliers and day circuit are controlled by switches located in the front of the house. The other lights are controlled at the switch box on the stage. The footlights will number ninety lights, thirty each of red, white and blue globes. The arrangement is such that either set can be used, according to the requirements of the scene. The lights were installed by the Marr Construction company, under the direction of W. S. Andrews. Kerite wire was used throughout the building.

G. A. HARTER, Manager.

The Electrical Construction Co.

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CONTRACTS TAKEN FOR THE ERECTION OF

Electric Light Plants Complete.

All Classes of HOUSE WORK a Specialty.

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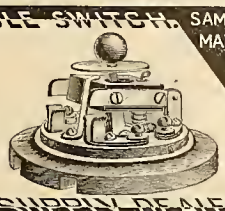

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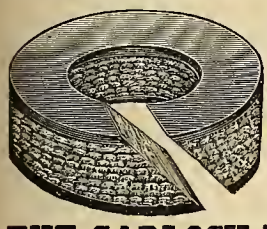

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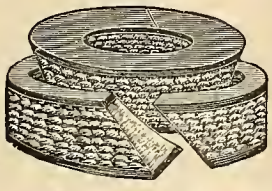

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The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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INSULATED WIRES AND CABLES,

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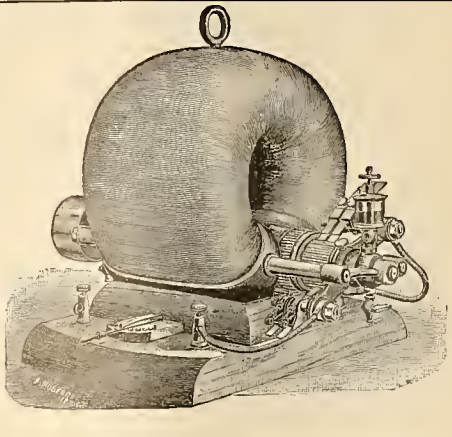

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N. B.—When applying for Catalogues, please state whether "Electric Bell" or "General Supply" Catalogue is wanted, and if in the trade inclose business card for discounts.
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Sealed Proposals
—FOR—
Lighting the City with Electricity.

MAYOR'S OFFICE,
NATCHEZ, MISS., Aug. 27th, 1888.

Notice is hereby given that sealed proposals will be received at the office of the City Clerk until **12 o'clock M., November 1st, 1888**, for lighting the streets, alleys, commons or parks of the city, with electricity, in accordance with plan and specifications to be placed in the City Clerk's office, for the period of five years, that is to say, that portion of the city now lighted with gas, from the 1st day of March, A. D., 1889, and that part lighted by coal oil lamps, from the 1st day of June, A. D., 1889.

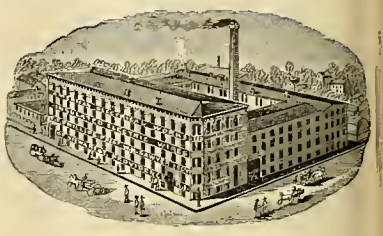
Each bidder is required to file with his bid a detailed statement of the number and location of the plants then in operation, of the particular system which he proposes to establish in Natchez if successful in bidding, and to specify as to each plant so in operation whether it is the one originally established in such locality or has been substituted for some other previously in use, and, if a substitute, then for what system.

The successful bidder will be required to enter into good and sufficient bond, of such penalty as the Mayor and Aldermen shall hereafter fix, conditioned that he will erect and have ready for use the electric plant, and begin the lighting of the city therewith, on the dates hereinbefore stated.

The Mayor and Aldermen reserve the right to reject any or all bids.

W. H. MALLERY,
Mayor of City of Natchez.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.
American Electrical Works.



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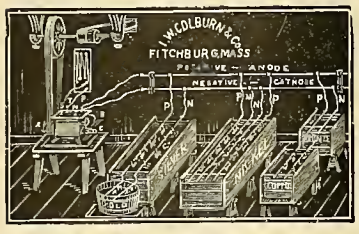

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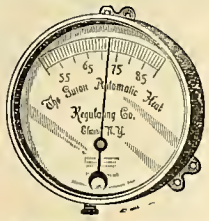

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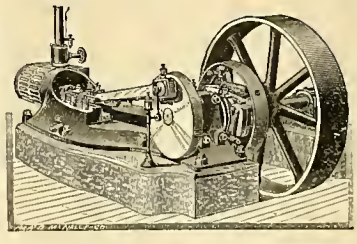

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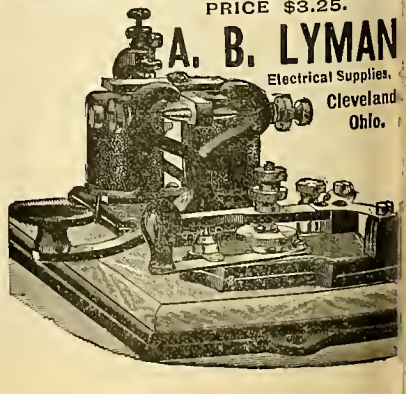

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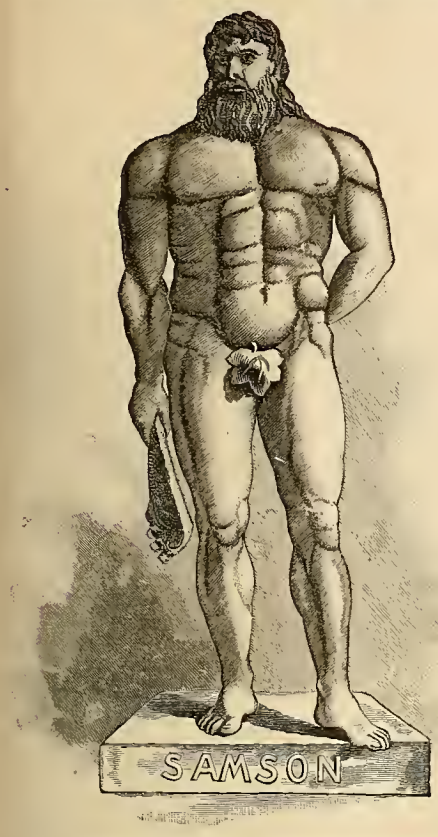
THE "SAMSON" BATTERY



Is a practical advance in Open-circuit Batteries in this country. It is really a "Samson" in strength. Its marvelous working power creates general surprise among practical electricians, but its simplicity surprises them more and they exclaim, "Why wasn't that thought of before!" In France, the home of Voltaic Batteries, the "Samson" takes the lead. Its rapid introduction and sale in the United States mark a new era for all electricians and fitters who have been annoyed by the uncertainty and burdened with the consequent high cost of battery power.

Report on the performance of three cells examined for their E. M. F., Internal Resistance and Current Strength by Prof. A. E. Dolbear.

NAME OF CELL.	E. M. F.	INT. RES.	CURRENT AT OUTSET.	C. AFTER 30 MINUTES.
Genuine Gonda "Disque" Lec.	1.46 volts.	1.25 ohms	.61 ampere.	.26 ampere
Samson No 1.	1.44 "	.14 "	1.16 "	.52 "
Samson No. 2.	1.47 "	.11 "	1.11 "	.70 "

"The cells were all put in circuit with a resistance of 1.1 ohms, and kept on that circuit for the above measure of current. The very small internal resistance of the two "Samsons" enables them to give a current very nearly twice as great at the beginning as the other, while the "Samson" No. 2 gave a stronger current (.70 ampere) after half an hour short circuit, than the Disque Leclanché cell at the beginning."

* * * *

"It appears therefore that the "Samson" cells are much more energetic than the one they were compared with; so much so, that one of them is about as good as two of the latter kind for such service as the production of strong current or strong magnetic effects."

* * * *

"I have also tested the "Samson" cells for telephone work and find them very superior. Their small internal resistance enables them to give a stronger current through the induction coil than any Leclanché cell I have ever tested. This amounts to 25 or 30 per cent. The cell meets my commendation."

The "Samson" Battery has a strong and handsome Glass Jar, non-corrosive connections, a Rubber Cover to prevent evaporation, inexhaustible Carbon Vases, and practically indestructible Zincs.

It will stand more hard usage, and continue its service longer and more stubbornly, than any other open circuit battery made.

It recuperates quickly after having been repeatedly overtaxed and short-circuited, and will do more effective work after such repeated short-circuiting than any other sal ammoniac cell.

☞We shall continue to ship one sample lot to any dealer, for trial, at 50 lot prices, F. O. B. Boston, until September 10, 1888.

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- Electric Gas Lighting.
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- Electro-Medical Apparatus,
- Electric Lighting.
- Telegraph Instruments.
- Wire and Batteries.

The United Electric Co.

Electrical Apparatus and Supplies.

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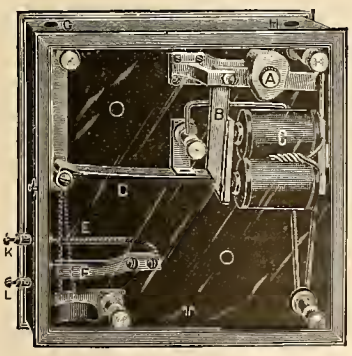
LACE LEATHER ROPE AND OTHER RAWHIDE.

GOODS OF ALL KINDS BY KRUEGER'S PATENT.

This Belting and Lace Leather is not affected by steam or dampness; has more grip than any other; never becomes hard; is stronger, more durable, and the most economical Belting made. The Rawhide Rope for Round Belting Transmission is **SUPERIOR TO ALL OTHERS.**

75 Ohio Street, - CHICAGO, ILL.



Protect your Armatures

It is a matter of every day experience among Electric Light men that Armatures are frequently burned out entirely or seriously injured by the short circuiting of machines. This entails delay, trouble and expense.

Wright's Armature Protector Absolutely Protects

Armatures from injury resulting from the short circuiting of machines. No machine can burn out if protected by Wright's Armature Protector. One of the most valuable inventions of recent years.

"Adapted to any System."

Now on the market. For information and prices, address

CHAS. D. WRIGHT, Petersburg, Ill.

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FOR PRIVATE LINES

The only Mechanical Telephone which has stood the tests and held out and given satisfactory service for the past eight years.

Send for Illustrated Catalogue and Prices. Electrical Goods of Every Description.

"ELGIN" TELEPHONE AND ELECTRICAL SUPPLY CO.

Room 7, Hubbard Block, - ELGIN, ILL., U. S. A.

VULCAN INSULATED WIRES

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FOR THE

ELECTRIC LIGHT TELEPHONE AND TELEGRAPH

MANUFACTURED BY

The Campbell Electrical Supply Co.

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B. D. BRAIDED WIRE.

THE POPULAR WIRE FOR INCANDESCENT WORK.

CRUMIDAWN TRADE MARK WHITE CORE INSULATED WIRE.

Safe and Reliable.

NEW YORK INSULATED WIRE CO.,

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FOR THE ERECTION OF STEAM PLANTS FOR ELECTRIC LIGHTING AND POWER STATIONS.

Armington & Sims Co. Engines belted direct to dynamos. Boilers set with the *Jarvis Patent Boiler Setting.* Burning Screenings, Sawdust, Cotton Seed Hulls without blast. National Feed-Water Heaters. National Rocking Grates. Sheffield Grates. Korting Double Tube Injectors, etc., etc. This System has been introduced among the following Central Stations in the United States, Canada, and other Countries, viz.:

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*Merchants' Electric Light Co.....Boston, Mass.
*Narragansett Electric Light Co.....Providence, R. I.
*Woonsocket Electric Light Co.....Woonsocket, R. I.
*Hartford Electric Light Co.....Hartford, Conn.
*New Haven Electric Light Co.....New Haven, Conn.
*Consolidated Electric Light Co.....Portland, Me.
*Lewiston Electric Light Co.....Lewiston, Me.
*New Bedford Electric Light Co.....New Bedford, Mass.
*Fall River Electric Light Co.....Fall River, Mass.
Syracuse Electric Light Co.....Syracuse, N. Y.
*Bridgeport Electric Light Co.....Bridgeport, Conn.
*Brockton Electric Light Co.....Brockton, Mass.
Milford Electric Light Co.....Milford, Mass.
Gloucester Electric Light Co.....Gloucester, Mass.
Bar Harbor Electric Light Co.....Bar Harbor, Me.
*Bangor Electric Light Co.....Bangor, Me.
Oak Island Electric Light Co.....Oak Island, Mass
Poughkeepsie Electric Light Co.....Poughkeepsie, N. Y.
Norwich Electric Light Co.....Norwich, Conn.
Newport Illuminating Co.....Newport, R. I.
*Waterbury Electric Light Co.....Waterbury, Conn.
*Worcester Electric Light Co.....Worcester, Mass.
Mobile Electric Light Co.....Mobile, Ala.
Intercolonial Electric Light Co.....Lima, Peru.
Wachusetts Electric Light Co.....Fitchburg, Mass.
American Electric Light Co.....Old Orchard, Me.
American Electric Light Co.....Martha's Vineyard, Mass.
Saratoga Electric Light Co.....Saratoga, N. Y.
St. John Electric Light Co.....St. John, N. B.
Union Electric Light Co.....East Boston, Mass.
*Brookline Electric Light Co.....Brookline, Mass.
*Pawtucket Electric Light Co.....Pawtucket, R. I.
Royal Electric Light Co.....Montreal, Can.
*Toronto Electric Light Co.....Toronto, Can.
*Newfoundland Electric Light Co.....St. John's, N. H.
Rutland Electric Light Co.....Rutland, Vt.
Halifax Electric Light Co.....Halifax, N. S.
*Nashua Electric Light Co.....Nashua, N. H.
Manchester Gas Co.....Manchester, N. H.
Newton Electric Light and Power Co.....Newton, Mass.
Ara Cushman & Co.....Auburn, Me.
North Adams Electric Light & Power Co.....North Adams, Mass.
Lawrence Gas Co.....Lawrence, Mass.
Waltham Electric Light and Gas Co.....Waltham, Mass.
Quincy Electric Light and Power Co.....Quincy, Mass.
North Shore Electric Light Co.....Beachmont, Mass.
Narragansett Pier Electric Light Co.....Narragansett Pier, R. I.
Palmer Electric Light Co.....Palmer, Mass.
Osaka Electric Light Co.....Japan.
Panama Electric Light Co.....Panama.
Colon Electric Light Co.....Colon.
Malden Electric Light Co.....Malden, Mass.
Cambridge Electric Light Co.....Cambridge, Mass.
Somerville Electric Light Co.....Somerville, Mass.
South Framingham Electric Light Co.....South Framingham, Mass.
La Fayette Gas Co.....La Fayette, Ind.
Charleston Electric Light Co.....Charleston, S. C.
Cohoes Electric Light Co.....Cohoes, N. Y.
Toronto Electric Light Co.....Toronto, Ont.
Newburyport Electric Light Co.....Newburyport, Mass.
Northampton Electric Light Co.....Northampton, Mass.
Boston Electric Light Co.....Boston, Mass.
Milbury Electric Light Co.....Milbury, Mass.
Southbridge Electric Light Co.....Southbridge, Mass.
Westboro' Electric Light Co.....Westboro, Mass.
Webster Electric Light Co.....Webster, Mass
Springfield Electric Light Co.....Springfield, Mass
Dover Electric Light Co.....Dover, N. H.
Empire State Electric Light Co.....Atlanta, Ga.
Jamestown Electric Light Co.....Jamestown, N. Y.
Houlton Electric Light Co.....Houlton, Me.
Torrington Electric Light Co.....Torrington, Conn.
Middletown Electric Light Co.....Middletown, Conn.
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EDISON ELECTRIC LIGHT SYSTEM.

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Edison Illuminating Co.....Menlo Park, N. J.
Edison Illuminating Co.....Harrisburg, Pa.
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*Edison Illuminating Co.....Lawrence, Mass.
Edison Illuminating Co.....York, Pa.
Miner's Theatre.....New York, N. Y.
Edison Illuminating Co.....New Bedford, Mass.
Edison Illuminating Co.....Lebanon, Pa.
Edison Illuminating Co.....Des Moines, Ia.
Hospital Life Insurance.....Boston, Mass.
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*Edison Illuminating Co.....Woburn, Mass.
Byron Weston.....Dalton, Mass.
N. E. Conservatory of Music.....Boston, Mass.
Rochester Illuminating Co.....Rochester, N. Y.
Rutland Electric Light Co.....Rutland, Vt.
Abilene Electric Light Co.....Abilene, Kan.
Topeka Electric Light Co.....Topeka, Kan.
Globe Co.....Boston, Mass.
D. S. McDonald.....Boston, Mass.
Edison Illuminating Co.....Chicago, Ill.
Boston Rubber Shoe Co.....Malden, Mass.
Electric Gas Light Co.....Laramie, Wyo.
Austin Electric Light Co.....Austin, Texas.
Edison Illuminating Co.....Palestine, Texas.
Capital City Electric Light Co.....Des Moines, Ia.
*Edison Machine Works.....Schenectady, N. Y.
Edison Illuminating Co, Station No. 2.....Boston, Mass.
Kellogg Terrace.....Great Barrington, Mass.
Richmond Light and Power Co.....Richmond, Va.
Forest City Light and Power Co.....Rockford, Ill.
Kansas City Illuminating Co.....Kansas City, Kan.
Edison Electric Illuminating Co.....Newport, R. I.
Hotel Berwick.....Boston, Mass.
Seattle Electric Light Co.....Seattle, Wash. Ter.

ELECTRIC RAILWAY CO.

West End Street Railway Co.....Boston, Mass.
Richmond Electric Railway Co.....Richmond, Va.
Syracuse Street Railway Co.....Syracuse, N. Y.
Meriden Horse Railroad Co.....Meriden, Conn.
Seattle Railway and Power Co.....Seattle, Wash. Ter.
East Side Street Railway Co.....Brockton, Mass.
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The Railway Telegraph Supply Co.

54 and 56 FRANKLIN ST., CHICAGO,

Manufacturers of and Dealers in

ELECTRICAL APPARATUS AND SUPPLIES,

ANNUNCIATORS, MAGNETO BELLS, BATTERIES, ETC.

WE CARRY A FULL STOCK OF J. H. BUNNELL & CO.'S TELEGRAPH INSTRUMENTS.

Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

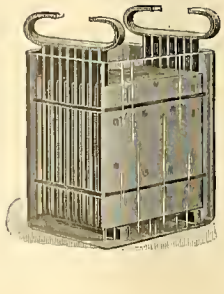
ELECTRICAL ACCUMULATORS or STORAGE BATTERIES,

Especially Adapted to

CENTRAL STATION LIGHTING,

Isolated Lighting, Railroad Car Lighting,

Street Car Propulsion, Long Distance Lighting.



Among the Advantages of this System are:

**Absolute Certainty of Light,
Increased Life of Lamps,
Great Economy of Running Expenses,
Absolute Steadiness of Current,
Utilization of Surplus Power,
Adaptability to Existing Plants,**

And Complete Displacement of Gas.

Inquiries from NORTHERN ILLINOIS, EASTERN IOWA, WISCONSIN and MINNESOTA should be addressed to the exclusive licensees for said territory,

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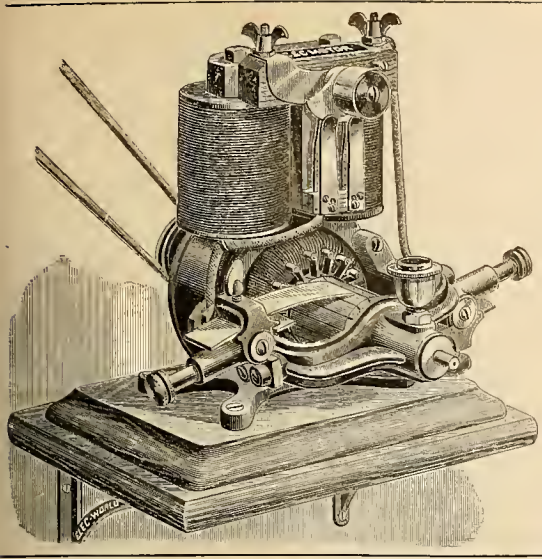
223 PHENIX BUILDING, CHICAGO, ILL.

Inquiries from other Territory should be sent to

The Electrical Accumulator Company,

44 BROADWAY, NEW YORK.



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EFFICIENT ELECTRIC MOTORS

MANUFACTURED FOR ARC AND INCANDESCENT CIRCUITS.

AUTOMATICALLY REGULATED.

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Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

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FOR ELECTRIC LIGHT, TELEGRAPH AND TELEPHONE LINES.

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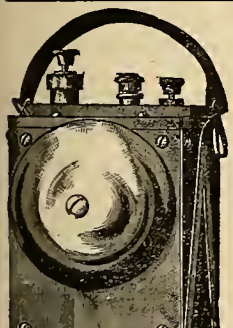
NEW YORK CARBON WORKS,

Send for Price-List. 18 Cortlandt St., Telephone Building, N. Y.



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Manufacturers, Importers and Dealers in

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Agents for EUROPEAN ELECTRICAL SPECIALTIES,
46 South Water Street, CLEVELAND, OHIO.

Complete Domestic Combination Outfits:

These sets require no technical knowledge to connect; they are all contained in black highly finished hard rubber cases, mounted in nickel plate and ready for use. The bell domes are all 3½ inches, the coils are wound with silk-covered wire, and the contacts are of platinized silver.

Three-Way Annunciator and Bell Set	$16.00
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Fire Alarm Outfit	$7.00 to 8 00
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Switchboards, Switches, Annunciators, Bells, Wires, Push Buttons, Alarm Contacts, etc.

WATERHOUSE SYSTEM

OF

Arc and Incandescent Lighting,

Long Distance Series Incandescent Lighting,

Multiple Arc Incandescent Lighting.

Our Instantaneous Automatic Regulator protects Lamps and Dynamos, and saves power. Gold Medal awarded, Mechanics' Fair, Boston, 1887, for perfection in regulation of current. Most perfect and economical System in the field.

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Chicago Office, 154 La Salle St.

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FRANCIS W. PARKER, Solicitor.

If you have an invention which has: First, been proven to be operative, second, allowed with broad claims in the U. S. Patent Office; third, illustrated fully by drawings and descriptions, we will without cost to you patent and exploit same in foreign countries.

Correspondence solicited.

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PRISM **GONDA** BATTERY

MARK.

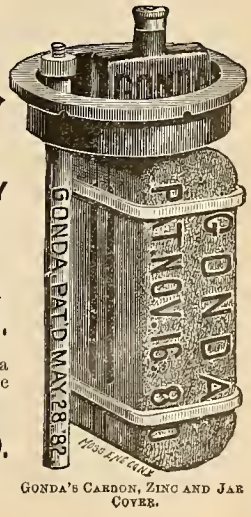
The Standard OPEN-CIRCUIT BATTERY of the World.

UNEQUALLED IN SIMPLICITY AND EFFICIENCY.

The great merits of this battery have brought out a number of infringements and worthless imitations. Beware of them.

The LECLANCHÉ BATTERY CO.

149 West 18th Street, New York.



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CENTRAL ELECTRIC COMPANY,

General Western Agents OKONITE TRADE MARK. Wires and Cables,

CANDEE WEATHERPROOF ELECTRIC LIGHT LINE WIRE.

ABSOLUTELY THE BEST.

A complete stock of General Electric Supplies always on hand. Shipments prompt.

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Electric Light Repairing. General Machine Job-Work. Pattern Making, Etc., Etc.

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Chicago Electric Club.

There will be a meeting of the *Chicago Electric Club* Monday evening, October 1st., at 8 o'clock, at the rooms of the Club, 122–124 Clark street.

GILES ANTI-MAGNETIC SHIELD FOR WATCHES.

Office of Van Depoele Electric M'fg. Co.
Chicago, Feb. 16, 1886.

Anti-Magnetic Shield & Watch Case Co.

Gentlemen : — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good timekeeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.

Sure protection from all Electrical and Magnetic disturbances. Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
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The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers ; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and in operative on account of their susceptibility to the all-pervading magnetic influence,

AMERICAN WATCH CO.,
Waltham, Mass.

GILES BROS. & CO. 103 State Street, CHICAGO.

LIST of SALES of WESTINGHOUSE ENGINES

COMPOUND, STANDARD AND JUNIOR, FOR THE MONTH OF AUGUST, 1888.

Alleghany Co. Light Co. (16th order), Pittsburgh, Pa.	150	H. P.,	Cp.
" " " " (17th "), " "	150	"	Cp.
" " " " (18th ") " "	150	"	Cp.
O. & C. B. Ry. & B. Co., Council Bluffs, Ia.	150	"	Cp.
Va. E. Lt. & P. Co. (3d order), Richmond, Va.	150	"	Cp.
" " " " (4th "), " "	150	"	Cp.
Colorado Elec. Co. (9th "), Denver, Col.	150	"	St.
" " " " (10th "), " "	150	"	St.
St. L. & San Franc. Ry. Co., Springfield, Mo.	125	"	Cp.
Cheney Bros., S. Manchester, Conn.	125	"	St.
" " (2d order). " "	125	"	St.
Pittsburgh Refining Co., Pittsburgh, Pa.	125	"	St.
O. & C. B. Ry. & B. Co. (2d order), Council Bluffs, Ia.	100	"	Cp.
Westinghouse Elec. Co. (12th order), London, Eng.	100	"	Cp.
St. L. & S. F. Ry. Co. (2d order), Springfield, Mo.	100	"	Cp.
Gd. Trunk Ry. Co. (6th order), Montreal, Can.	75	"	St.
" " " (7th "), " "	75	"	St.
Bryden Horse Shoe Co., Catasaqua, Pa.	75	"	St.
Wyatt Park Ry. Co., St. Joseph, Mo.	75	"	St.
" " " " (2d order), " "	75	"	St.
Baldwin Loco. Works, (9th order), Philadelphia, Pa.	65	"	Cp.
Quaker City Dye Works, Philadelphia, Pa.	60	"	St.
M. E. Lt. & P. Co. (4th order), Morristown, N. J.	60	"	St.
Norwich E. L. & P. Co., Norwich, N. Y.	60	"	St.
Pencoyd Iron Works (4th order), Philadelphia, Pa.	50	"	Cp.
Darlington Ginning & Mill Co , Darlington, S. C.	50	"	Jr.
Tate & Sons, Baymer, Mo.	5	H. P ,	Jr.
Dealer, San Francisco, Cal.	50	"	Jr.
A. B Bary (4th order), Moscow, Russia.	45	"	St.
Forestdale Mfg. Co., Providence, R. I.	45	"	St.
Nova Scotia Steel Co., New Glasgow, N. S.	35	"	Jr.
St L. & San F. Ry. Co. (3d order), Springfield, Mo.	35	"	Jr.
Foster Bros., Atlanta, Ga.	35	"	Jr.
Waverly Stone Co. (2d order), Holland, Mich.	35	"	Jr.
Dealer, Dallas, Tex.	35	"	Jr.
J. W. Schadewald & Co., Minneapolis, Minn.	35	"	St.
Lincoln Iron Works. (2d order), Rutland, Vt.	35	"	St.
Anton Schollmeier, Pine Bluffs, Ark.	35	"	St.
Cum. & Pres. Mills, (5th), Cumberland Mills, Me.	35	"	St.
The Crown Mills, (2d), Marcellus, N. Y.	35	"	Jr.
Washington Gas Co., Washington, Ind.	35	"	St.
Darlington Ginning & M. Co., (2d ord.), Darlington, S.C.	25	"	Jr.
Ada Mfg. Co., Charlotte, N. C.	25	"	Jr.
Paesaic Print Works (2d ord.), Dundee, N. J.	25	"	Jr.
G. H. Nichols & Co., (5th ord.), New York.	25	"	Jr.
McArthur Bros. (2d ord.), Danbury, Ct.	25	"	Jr.
Canton Steam Pump Co., (2d ord.), Canton, O.	25	"	Jr.
Burrell Chemical Co., Newberry, Mich.	25	"	Jr.
" " (2d ord.), Newberry, Mich.	25	"	Jr.
Dealer, Dallas, Texas.	25	"	Jr.
Lawrence Mach. Co., (35th ord.), Lawrence, Mass.	25	"	Jr.
Bryden Horse Shoe Co., (2d ord.), Catasaqua, Pa.	25	"	Jr.
Chambers Turner & Layton, Truro, N. S.	25	H. P.,	St.
R. Mackintosh, Lundy, Utah.	25	"	St.
Oil Well Supply Co , Pittsburgh, Pa	25	"	St.
Keating Imp. and Mch. Co , Beckville, Tex.	15	"	Jr.
Dealer, Dallas, Tex.	15	"	Jr.
Elberton Oil Mill, (2d ord.), Elberton Ga.	10	"	St.
Betts Street Furniture Co., Cincinnati, O.	10	"	Jr.
American Glucose Co., Peoria, Ill.	10	"	Jr.
" " " (2d ord), Peoria, Ill.	10	"	Jr.
" " " (3d ord,), " "	10	"	Jr.
H McMorran, Port Huron, Mich.	10	"	Jr.
Westinghouse Elec. Co. (13th ord.), Pittsburgh, Pa.	5	"	St.
Chambers. Turner & Layton, Truro, N. S.	5	"	Jr.
Dealer, San Francisco, Cal.	5	"	Jr.
" "	5	"	Jr.
S. Bethlehem Gas & W. Co S. Bethlehem, Pa.	5	"	St.
Penna. R. R (10th ord), Camden, N. J.	5	"	St.
Lawrence Mach. Shop, (36th ord.), Lawrence, Mass.	5	"	St.

SUMMARY.

12 Compound Engines, aggregating	1,440	H. P.
27 Standard " "	1,590	"
31 Junior	740	"
Total, 70 Engines, aggregating - -	3,770	H. P.

Note the Repeated Orders. Note the Character of Customers. Note the Distribution of Trade. Note the Volume of Business, and Draw your own Conclusions.

THE WESTINGHOUSE MACHINE COMPANY, - - PITTSBURGH, PA.

The Woodbury

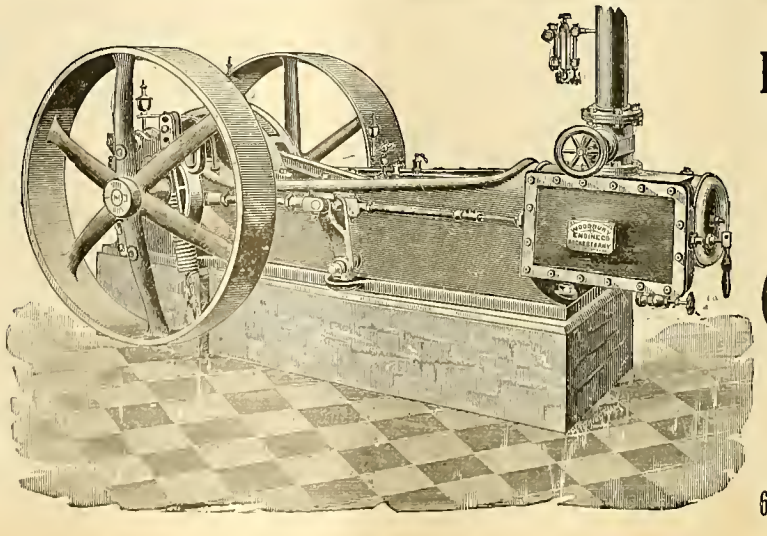
AUTOMATIC

Cut-Off High Speed

ENGINE.

MANUFACTURED BY

WOODBURY ENGINE COMPANY.



ALSO BUILDERS OF

PLAIN SLIDE VALVE

—AND—

Double Valve Medium Speed

AUTOMATIC

Cut-Off Engines

—AND—

TUBULAR BOILERS.

Address the Manufacturers at

652 Mill Street, ROCHESTER, N. Y.

SYNOVIAL
Dynamo and Cylinder Oils.

Second to none. Free from gum or acids. Especially adapted for all fast runnning machinery. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

S. TAUSSIG, Agent, - - 43 River St., CHICAGO.
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THE FOREST CITY PACKING COMPANY,

CLEVELAND, OHIO, U. S. A.

MANUFACTURERS OF THE

Patent High Speed Packing,

MADE ESPECIALLY FOR ELECTRIC LIGHT ENGINES.

Delivered Free on 60 Days' Trial. Satisfaction Guaranteed, or no Pay.

United States Electric Fire Alarm Co.

EVART, MICHIGAN.

PROPRIETORS OF THE

Chase Police and Fire Alarm Telegraph

SYSTEMS,

The most Efficient, Durable and Reliable now in use, and giving entire satisfaction in different cities and villages in the United States.

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BAKER'S TRIPOLINE!

A Powerful and Rapid Cleaner and Polisher of Metals without Acid or Poison.
Especially Adapted to Railroad, Marine, Stationary and Fire Engine Work, "hot or cold;" Large Signs, Railings, etc.

This polish is now being supplied to Hundreds of Mechanical Engineers **ELECTRIC LIGHT PLANTS**, and manufacturers of Machinery. Has already been adopted by many of the leading railroad companies, the leading fire departments, water works, the U. S. Ordnance and Navy Departments, and thousands of Mills, Factories, etc. Is the BEST AND CHEAPEST POLISH IN THE WORLD, and quickest Cleaner. **Unequaled for Cleaning and Polishing Carbon Holders.** Send for Sample, FREE. Liberal discount to manufacturers and dealers in **Electrical Machinery.** Manufactured only by the

MATCHLESS METAL POLISH CO., - - 88 MARKET ST., CHICAGO, ILL.

NEW PATENT GAS ATTACHMENT

FOR FITTING ELECTRIC LIGHT SOCKETS TO GAS FIXTURES.

No more burnt wire conductors where this attachment is used.

Remove gas burner, screw nozzle in its place; by replacing and screwing gas burner on nozzle, you effect a permanent gas tight job. Send orders to **FRANK S. MARR**, Contractor.
CHICAGO AGENTS, THE ELECTRICAL SUPPLY CO., 171 Randolph Street. Bissell Block, PITTSBURGH, PA.

14 YEARS. **DSO** SEND FOR NEW PAMPHLET OF 1873-1887. **RECORDING**

Pressure Gauges.

NO EXPERIMENT.

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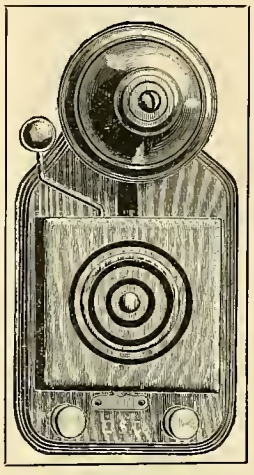

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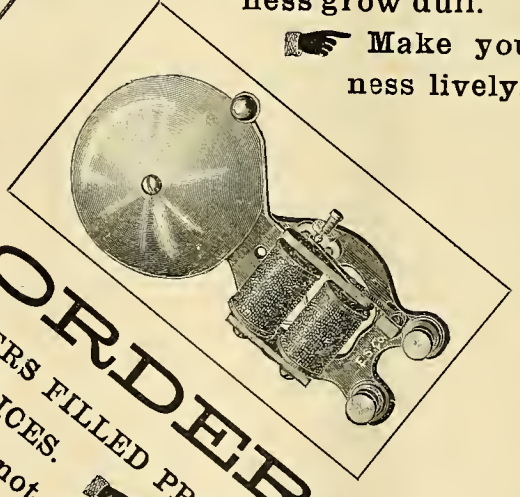

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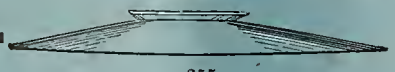
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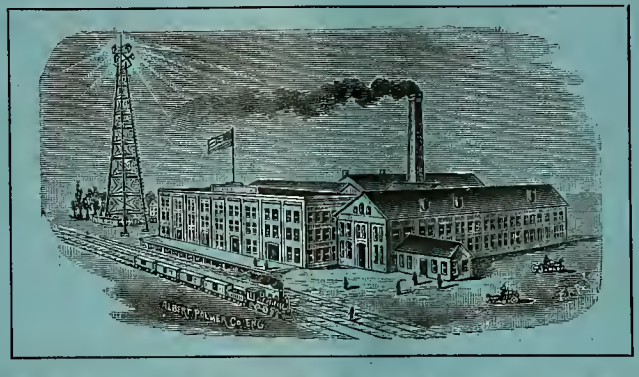

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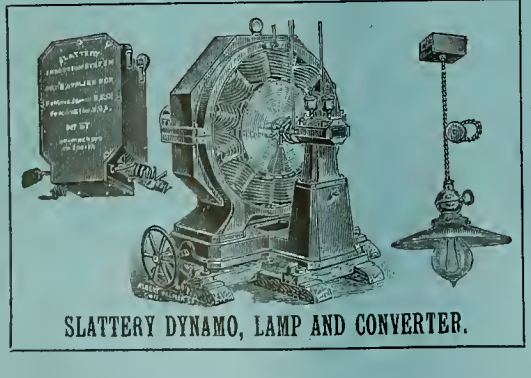

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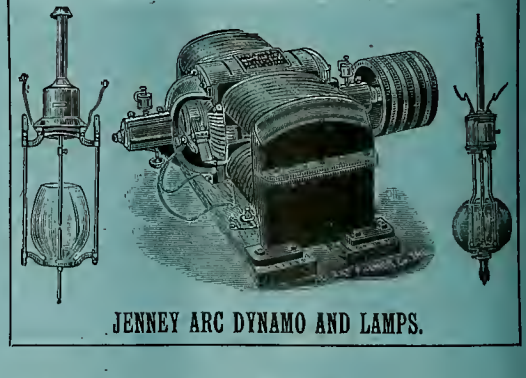

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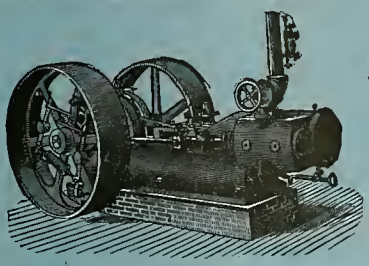

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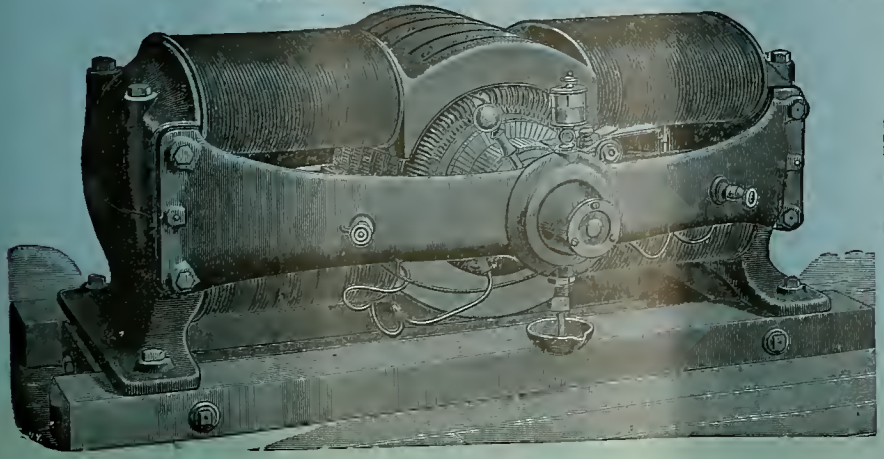

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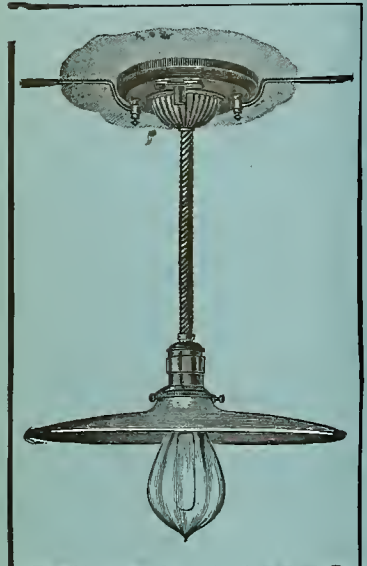

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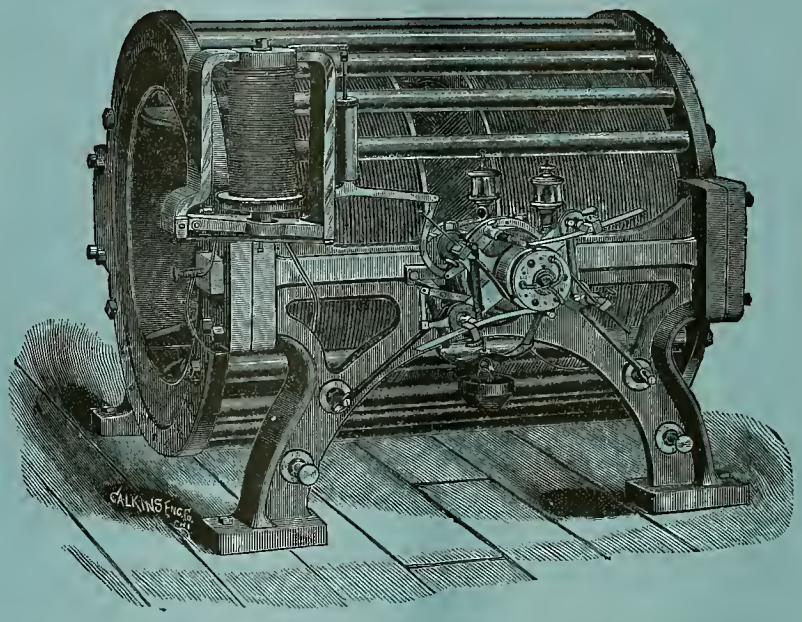

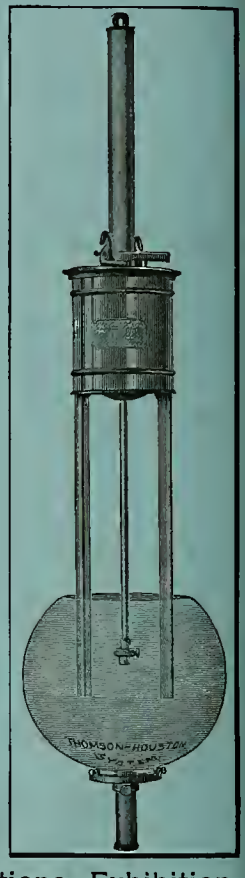

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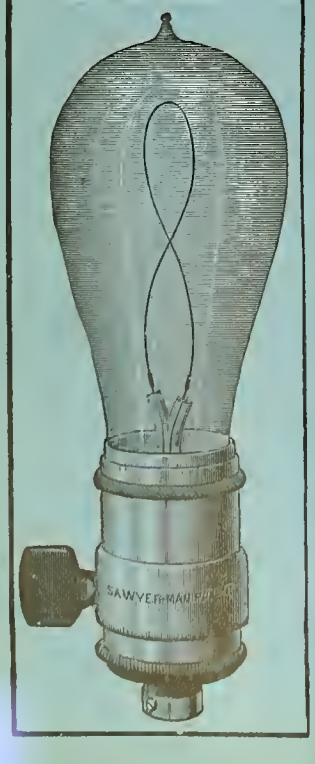

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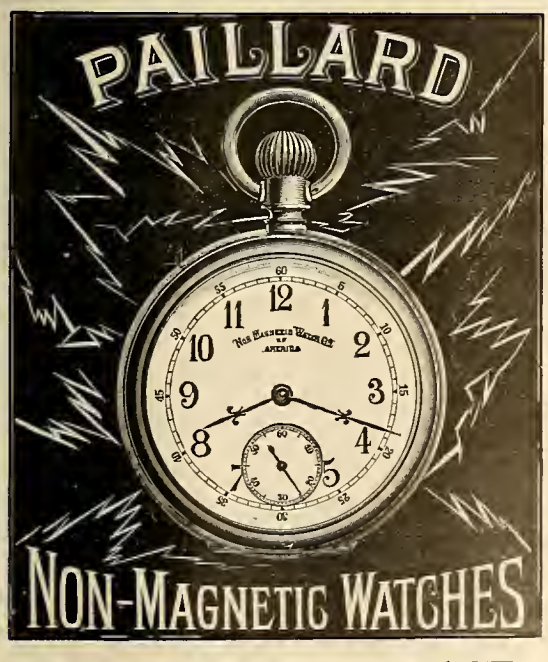

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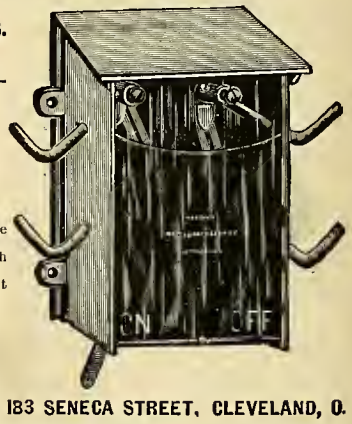

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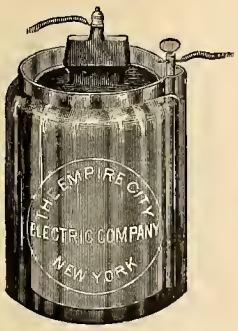

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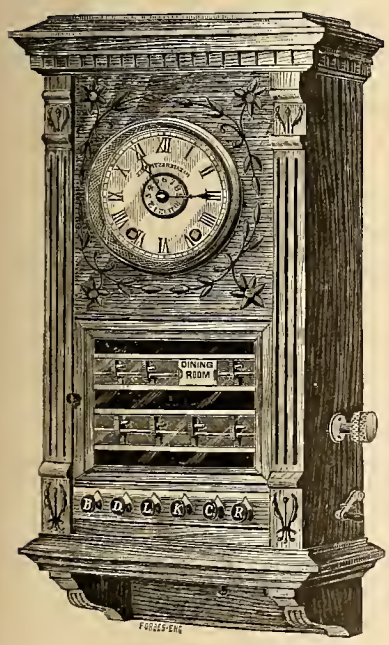

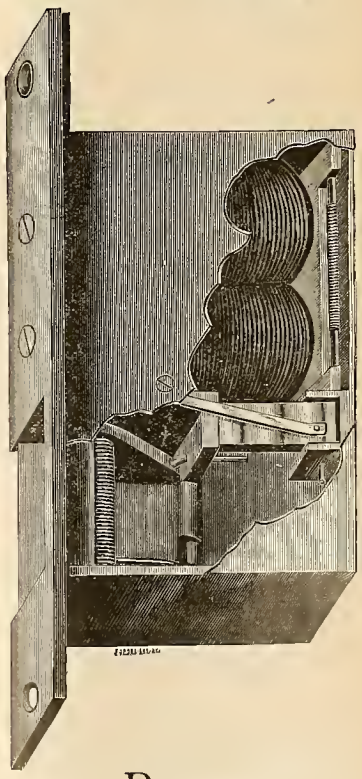

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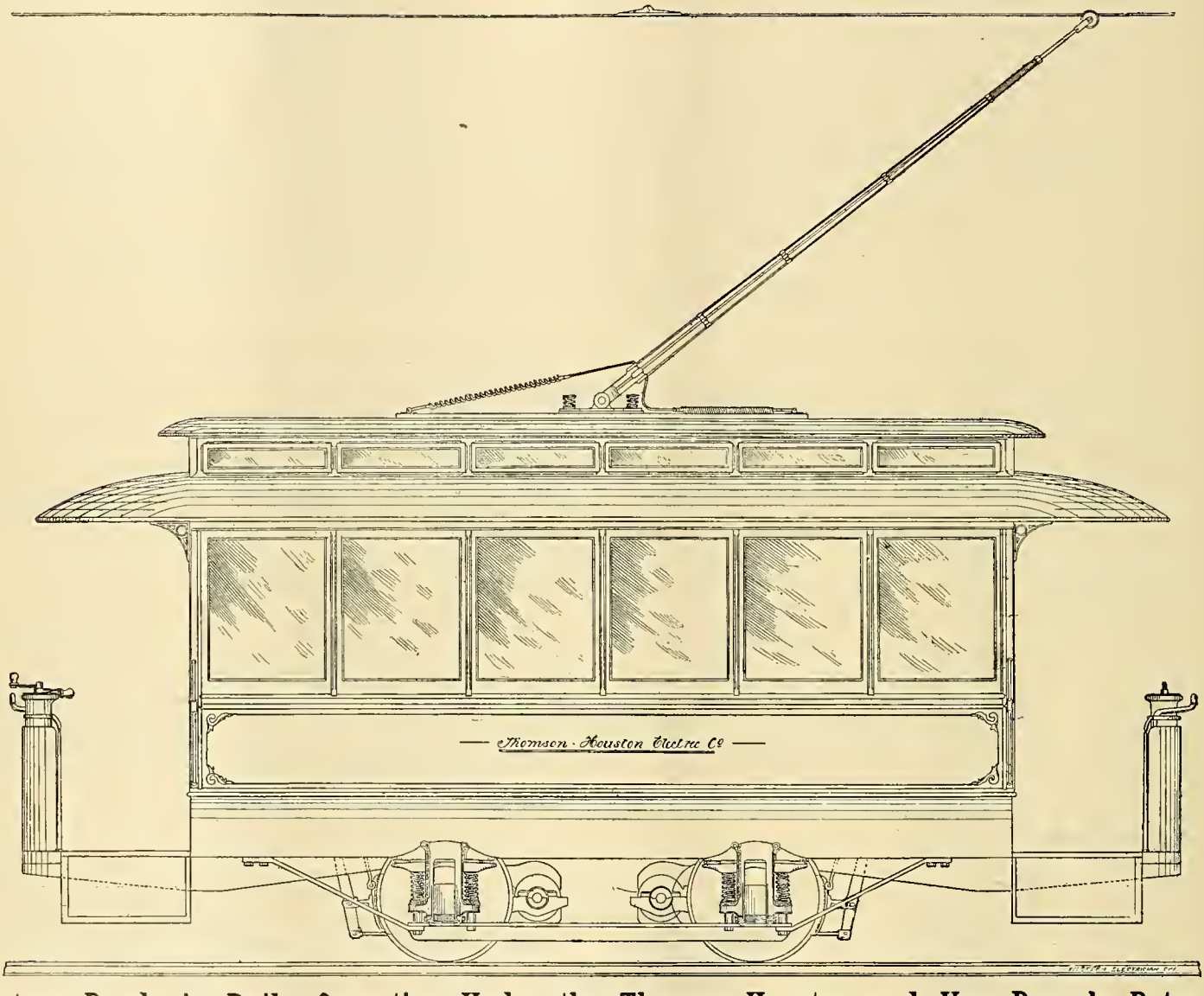

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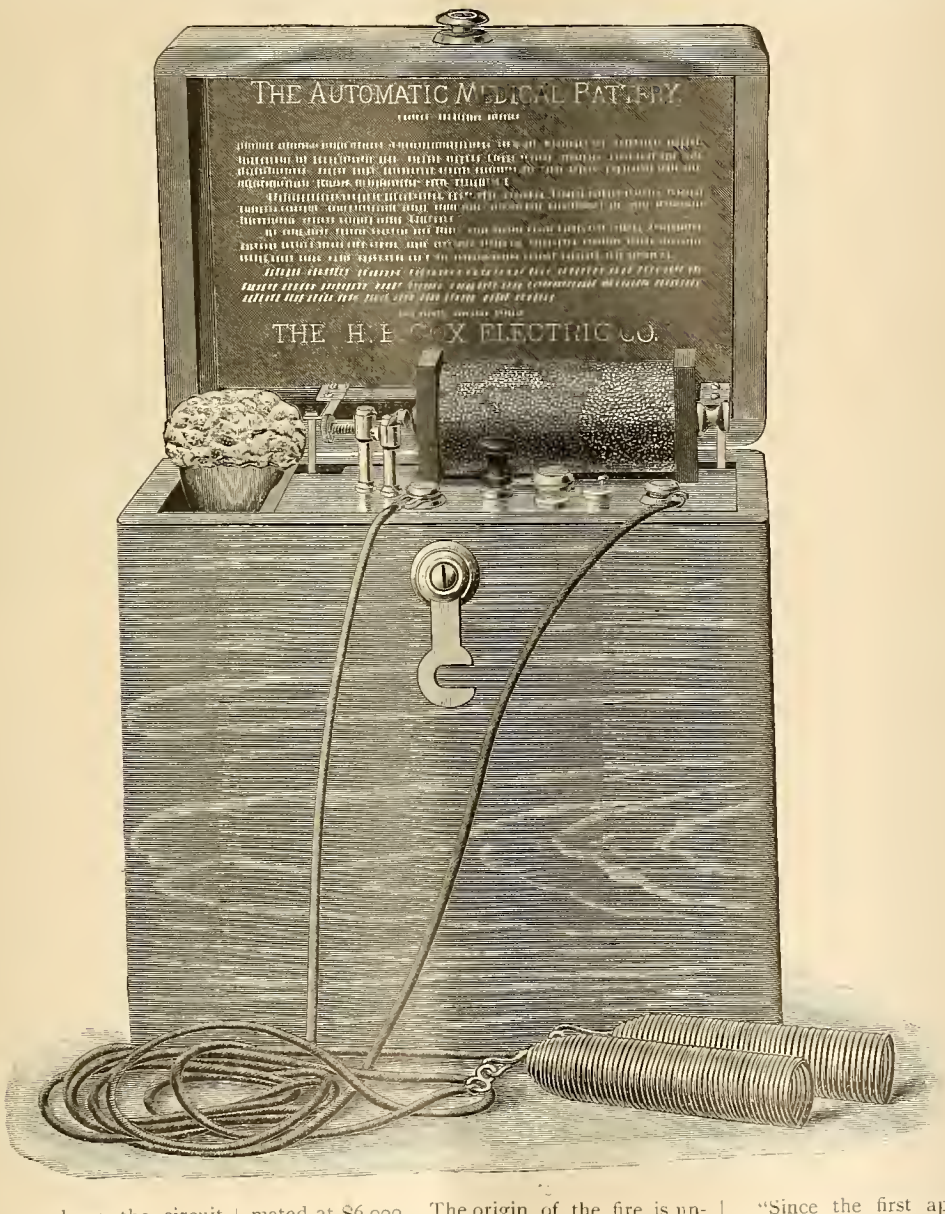
Vol. III. CHICAGO, SEPTEMBER 22, 1888. No. 12.

Automatic Medical Battery.

The illustration in connection shows a new automatic medical battery made by the H. B. Cox Electric company of New Haven, Conn.

The battery is put up in a cherry case eight and three-fourths inches high, which weighs eight pounds. The electric current is generated by a gelatine battery cell, which is semi-solid and perfectly sealed, so that there is no battery fluids to splash over.



Opening the lid or cover closes the circuit and places the current immediately in operation; closing it stops it.

This instrument produces three distinct currents—the galvanic, the faradic and the galvano-faradic. These currents are controlled by a switch, and can be varied from one scarcely perceptible to the feeling to one of a very high tension and capable of producing a perceptible spark, all the modifications between these extremes being at the control of the operator.

The battery is intended for the use of physicians, and in the family.

Fire in the Station of the Chicago Arc Light & Power Company.

Fire was discovered in the north side station of the Chicago Arc Light & Power company about 1 A. M. Sept. 10th. The station is situated at the corner of Clark and Elm streets. The fire had gained considerable headway before the department reached the ground. Four dynamos and three Ball engines were badly damaged by fire and water. The total loss is estimated at $6,000. The origin of the fire is unknown. The station shuts down at midnight. The engineer and fireman left about 12:45, and locked the doors. Fifteen minutes afterward the fire was discovered. About 155 lights are supplied with current from the station. Two of the circuits were cut into the main station of the company, and there was no interruption of the service of 92 of the lights. The other lamps were out for three or four days.

The Duluth, South Shore & Atlantic Railroad company, of Marquette, Mich., have increased their arc light plant by purchasing a number of Brush arc lamps.

Dental Electrics.

The Western Electrician a few months ago contained an article on "Dental Electrics." The following extract from an article in the St. Louis *Globe-Democrat* relates to the same subject:

Of late electricity has been taken up very largely by the dentists in their work. An officer of a leading dental supply company, when questioned on the subject, said:

"Since the first application of machinery to the lightening of the labor of the operative dentist, many devices have been tried in the search for a substitute for the foot power engine which should do its work effectively. So attractive a field for the employment of a reliable motive power for light running machinery could not be permitted to lie fallow, and it has been the inspiration and hope of inventors in all parts of the world. Devices for the generation and transmission of power have multiplied, and advances have followed one another rapidly.

"Water motors of various descriptions have

been presented, some of them meriting approval in themselves, but their field of usefulness has been limited, owing to variations in water pressure, or stringent or prohibitory regulations governing their use, so we have not felt warranted in bringing them prominently before the profession. Among other devices offered have been a variety of spring motors, all, however, open to serious objections, and diminutive, consequently non-effective, and somewhat dangerous, steam boilers and engines.

"Finding satisfaction in none of these, we have given earnest attention to electricity as affording the most likely solution of the problem. From time to time we have introduced to the profession various forms of batteries, motors, etc., each succeeding device possessing important features not contained in its predecessor. The first crude application of electricity to the uses of the dentist in the rotation of burrs, drills, etc., has been followed by improved appliances for the generation and transmission of the current, which, properly managed, leave little to be desired in this direction. The electric mallet is still, as it has been for years, the nearest approach to the ideal condensing instrument. The electrical current has found still other important uses in dentistry in the electrical mouth-lamp and laryngoscope and the electrical lantern, and in the kindred devices for other surgical specialties, the electrical laryngoscope, the electrical otoscope, the electric cautery snare, etc.

"To those who study the nature of electricity, and thus learn to regulate it in conformity to the duty which it has to do, its use is simple, effective and profitable. As a motor for engine or plugger it saves the excessive fatigue necessarily attendant upon the continued use of the foot power. In the mouth-lamp it is the surest known means of diagnosing dead teeth or devitalized pulps."

A special electrical motor has lately been made for dental engines. It is very light, weighing only 3½ pounds, but is of sufficient strength to supply any amount of power needed in operative dentistry.

On the theory that the pain experienced in the excavation of sensitive dentine is lessened as the speed of the burr is increased, there has been devised a double-inductor electric motor for dentistry that is a remarkable affair. It is claimed for it that with a battery current of sufficient strength it will lift 2,000 times its own weight 1 foot per minute. Its weight is 38 ounces. By pressing a lever or button with the foot a burr may be run by it at any speed desired up to 10,000 revolutions per minute. By adding more battery cells a still higher rate may be attained.

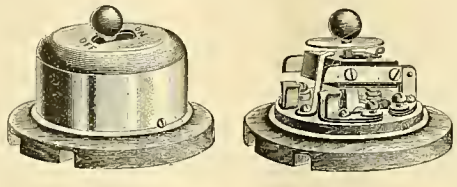
A very valuable assistant to the dentist is an electric mouth-lamp. Sound teeth have been needlessly sacrificed in fruitless endeavors to find the seat of neuralgic pains for which, owing to the insufficiency of the means of diagnosis, no satisfactory cause could be established. The electric mouth-lamp prevents this, and illuminates the cavity so brightly that any departure from normal conditions, whether it be a hidden cavity of decay, an unsuspected dead pulp or even the slight thickening of the tissues, which is the precursor of decay, is very certain to be detected. This lamp is an incandescent electric light mounted permanently in a non-conducting case or cylinder of hard rubber. It is supplied with metal conductors which pass outside of the reduced section of the case. The lamp case is carried in another hard rubber cylinder, called the lamp holder, which is also supplied with metal conductors fitting those on the lamp case, the two parts, when adjusted, being clamped together by a set screw. For the examination of posterior cavities in teeth a mirror, set at an angle of forty-five degrees, is attached to the end of the guard. With this attachment the lamp forms a perfect laryngoscope.

The electric plugger, or mallet, is another instrument that is proving a great help to the dentist through the use of electricity. Its chief advantage is the saving of time and fatigue attendant upon the use of hand, automatic or foot-power mallet. The blow is delivered upon the packing instrument just when its force is greatest, because the attraction of the magnets increases constantly as the mallet approaches them, until the circuit is broken. The battery which furnishes the power to the mallet consists of four cells, and once properly charged it will retain its efficiency a month.

New Dynamic Incandescent Switch.

Novel features of a new double pole switch that has very recently been put on the market by the Hartford Dynamic company of Hartford, Conn., are shown in the accompanying cut. This illustration shows clearly the appearance both with and without the cover, and most of the details of construction. The upright bent lever which projects through the cover and serves as a handle is connected at the back end through a spiral spring to a tilting block of hard rubber or other insulating material. This block carries the movable portions of the metallic circuit.

When in the act of closing the circuit the spring is stretched; when breaking it is compressed, but as soon as the hand is removed the lever moves slightly until the spring is in equilibrium; being then of its natural length it should maintain its elasticity unchanged. But it must not be supposed because the lever can be moved slightly by the spring that the block can be so moved and the contacts made uncertain; it is impossible to have them more certain, for the block is effectually locked in position or closed, and cannot be moved to the other position except through the use of the lever or a force great enough to break the switch. This ingenious locking device consists of two pins in



the block working around a four-sided steel lug in the lever. Assume the switch "off," the circuit open; as the lever is drawn upward the spring is stretched, but the block cannot move until the lever has gone far enough to allow the pins to slip from the lug; by this time the spring has been stretched to its utmost and the side bars are carried down firmly into the jaws; it is impossible for these contacts to separate by a rebound of the parts, for the pins and lug prevent; or by carrying the lever too far, for this keeps up the tension on the spring until the hand is removed. Similarly if the switch is "on," the movement of the lever first compresses the spring, and then releases the locking mechanism so that the block flies up and opens the circuit.

The illustration further shows that the jaws for contact are short; this is considered a decided advantage to the user, for the fitting must be accurately done or it would not pass inspection at the factory, and the jaws are much less likely to get bent out of shape in handling or use.

The cover is of a tasteful shape with rounded shoulder instead of square, and nickel plated; the dust cap prevents trouble from dust and insects. The lettering shows at once whether the current is "on" or "off," although the lights may not be visible.

Constitution of the Electric Light Association.

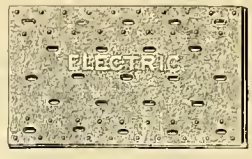
An annoying error, which by the way, was corrected on several successive proofs, crept into a part of the edition of September 8th. Art. VI of the revised constitution of the National Electric Light association should read:

"*Ballot.*—On any question before the association a ballot may be demanded by *ten* of the members present."

London is at last to have an electric railway. The City of London & Southwark Subway company have authorized the directors to make arrangements for working the line by electricity. It was at first intended to employ the cable system but the company upon investigation, learned that the electric system was preferable.

Perforated Leather Belting.

The cut in connection illustrates a novel method of preventing air cushions in belts run at a high rate of speed. The perforations are made in a regular and uniform manner, and at equal di tances apart over the entire surface of the belt; insuring equal tension and leaving the tensile strength of the belt uninjured. Besides preventing air cushions these belts are said to run more smoothly, steadily and with less



noise than ordinary belts. They are adapted to high speed dynamos.

Chas. A. Schieren & Co., 40 South Canal street, Chicago, have been granted a patent on this article, dated May 24, 1888, and have just completed the machinery necessary for its manufacture.

Chicago Telephone Matters.

At the meeting of the Chicago city council Sept. 10 Alderman Landon presented an ordinance giving the Chicago Telephone company the right to lay its wires in that portion of the city where they are now underground in conduits, and outside that territory, along properly constructed poles. The company offers to supply telephones to the city public offices free of charge as a consideration for the franchise and to comply with the other provisions of the old ordinance, which has expired by limitation. There is no limitation as to charge. The ordinance was referred to the committee on fire and water. Alderman Landon said he did not know who drafted it. The ordinance was handed to him as he came to the council. He introduced it because he thought there ought to be some ordinance. The telephone company was now operating without legal authority. The ordinance introduced could be made the basis of action. It should, of course, be amended. Both a maximum rental should be stipulated, and a license fee provided for. Alderman Ernst introduced an order directing the law department to proceed at once to dissolve the injunction granted about five years ago against the city interfering with the wires of the Chicago Telephone company, and calling upon the law department to test in the courts whether the company had any right to use the streets to lay and operate wires. The subject was referred to the committee on licenses, as was also a subsequent order fixing telephone charges at $75 a year.

A meeting of the license committee of the Chicago city council was held Sept. 13 to consider the telephone question. It was decided to recommend the passage of a resolution by the council directing the law department to take measures to dissolve an injunction obtained by the telephone company against the city in 1883 restraining the municipal authorities from cutting the overground telephone wires then strung or otherwise interfering with the plant of the telephone company. This injunction was allowed to stand by Mayor Harrison on the understanding that the telephone company would place all its wires within the business district in conduits from time to time. The committee further directed the corporation counsel to prepare such an ordinance for the regulation of the Chicago Telephone company as would protect the city's interests, and which would fix the annual rental at $75 per 'phone in accordance with a petition signed by over 3,000 renters. The committee discussed the right of the council to fix the rental. The corporation counsel declined to express a decided opinion on this question.

Earth for a Lightning Conductor.

In selecting and fixing an effective lightning conductor it must be remembered that a good earth is desirable. Dr. Lodge says, as quoted by London *Electrical Review:* "A few tons of coke with the conductor coiled up amongst it is a well known and satisfactory plan if the soil be permanently damp. A bag of salt might perhaps be buried with it to keep it damp throughout, or rain water may be led there. Often, however, the most violent thunderstorms occur after a spell of fine weather, and the soil is likely to be dry. It is best, therefore, to run your conductor pretty deep, and there make earth. It is all very well to connect the conductor to water mains, if near, but if they are far off or non-existent it is no use; and in no case, in my opinion, should they be used as sole earths. Certainly not gas mains. In dry weather they are not earthed at all well, and a strong charge may then surge up and down them and light somebody else's gas in the most surprising way. It does not often happen, but it may happen in sandy soil after dry weather. Always there should be a good deep earth—a well if possible, a boring if not—and the conductor led down into it. If it likes to make a disturbance when it has to leave the conductor a long way down, no one need grumble. It can't do much harm there. There is, of course no magic in water, unless it forms a large continuous sheet. A thoroughly good earth is really a geological question; and for an important building a geological specialist should be consulted. An occasional test of an earth, in ordinary weather, is no real security as to what may happen after a long-continued drouth."

Paillard's Non-Magnetic Balances.

Theo. Gribi, in a published communication, sets forth the results of tests, continued without intermission for nearly four months on three watch movements of the Paillard non-magnetic type, conducted with the idea of proving whether the balances were wholly exempt from the influences of magnetism, and at the same time adjustable to heat and cold. He quotes from a report to the manufacturing company:

"I did not at once subject your watches to the influence of a powerful dynamo, as you suggested and as others have done, for that seemed to me a very unsatisfactory proceeding. What I desired to know, and what is the real point at issue, is not to find out whether the watches would stop or not when exposed to magnetic influences at any time, but whether, though they might not actually stop, they would not suffer abnormal variations in their rate as the result of such exposure. But to be sure that whatever variations might occur in their rate would not be due to other disturbing causes, it is necessary that such a trial should be made under known conditions. It was important, too, that the temperature should be uniform throughout the trial under magnetic influence, or at least accurately known.

"It was necessary that the watches should be placed where the comparison with standard time could be made easily and without transporting them and subjecting them to chances of variations from position errors; and above all, it is an essential condition for accurate observation of phenomena of any kind that the observer be undisturbed, in no hurry, and in full control of all the conditions necessary to insure reliable results. These and other conditions, it seemed to me, could not be realized around and about a dynamo.

"With a view, therefore, to the elimination of errors arising from all these and other sources, I proceeded to rate the watches in my own office, and first in a perfectly non-magnetic medium. The comparisons were made with a standard chronometer, and this was compared daily with observatory signals from both the Washington and Dearborn observatories.

"The hour chosen for making the comparisons was between 12 and 1 o'clock P. M., immediately after the signals are usually corrected, if necessary, and to guard against possible mistakes they were repeated every time after the watches were wound. After about two weeks, and when the rate of the watches was fully established, I commenced subjecting each of them to a six-inch magnet, Fig. 1, first at a distance of an inch and a half from them, then in contact with, and finally on the poles of the magnets.

"When running in this last position the orientation of the movements was changed alternately with the twelve and six, then with the nine and three figures of the dial on the poles, the watches running in a horizontal position—dial up—throughout the trial. In each and all of these conditions the rating was continued during a period not less than five days. The rates were estimated to the nearest tenth of a second and the comparisons were always made at the same point in the second's circle of the dials. With all these precautions to guard against errors, I am positively certain that the result of the trial furnishes a reliable basis for conclusions.

"It is proper here to mention that two of the movements you sent me had steel forks and escape wheels, Fig. 2, while in the third these parts are also made of non-magnetic metals, Fig. 3. The result of this is that the rate of those with steel forks varied slightly when they were running on the poles of the magnets, and particularly upon changing their orientation, while the third, with non-magnetic escapement throughout, showed no perceptible variation that could positively be attributed to the influence of magnetism.

"This variation of the rate of those with steel forks was at first a disappointment to me; but on continuing their rating again in a non-magnetic medium they resumed their former uniform rate.

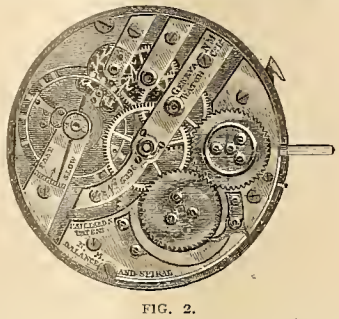


FIG. 2.

From this it would appear that the influence of the magnets had left no permanent effect on the watches. To satisfy myself of the correctness of this conclusion, I took the two with steel forks and placed them on a thirty-eight light dynamo. One of them immediately stopped; the other kept on going. They were then rated as before in a non-magnetic medium for ten days, and their rates were identically the same as before, and just as uniform.

"To me this is the most gratifying result of the trial. It shows that a watch need only have a non-magnetic balance and hair-spring, and perhaps the rollers might be such also to be wholly proof against the influences of magnetism for all ordinary purposes. The test of the adjustability to temperatures of the balances was made afterward, and under conditions equally severe, and the result also wholly establishes your claims."

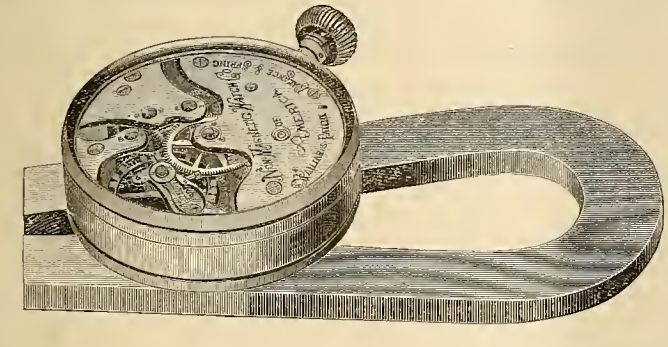
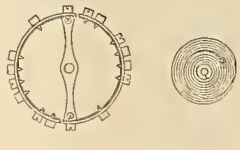


FIG. 1.



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

The Van Rysselberghe System at Brussels.

Messrs. Mourlon of Brussels, have given a very successful demonstration of the Van Rysselberghe system at the Exhibition, writes the Brussels correspondent of the London *Electrician*. They have erected two telephone offices, in each of which there is a complete set of Morse apparatus by the side of the telephone transmitters; the two offices are connected by an overhead wire, and talking can be carried on from either end while the Morse apparatus is at work. As an instance of the extent to which this system is in use it may be mentioned that in Europe alone more than 1,300 miles of telegraph wires are so worked, not to speak of the lines in the United States, Egypt, Mexico, Colombia, China, Japan, Costa Rica, Venezuela, Brazil, Uruguay, and the Argentine Republic. The same firm also exhibit the Dejough microphone, which has been adopted by the Belgian government, and is actually in use on the Paris-Brussels trunk line, over two hundred miles in length. According to a report of the Societe Belge d'Electriciens; this apparatus possesses the most exceptional qualities for the purpose of the transmission of speech. "An experiment frequently repeated and always most successful will give an idea of the value of the system. The listener at the Paris end of the line was able to repeat word for word the sentences whispered by the speaker at Brussels in such a low tone as to be inaudible two meters off." The Dejough transmitter is on the multiple carbon contact principle, and needs no regulation. Several models of the instrument are shown adapted to various uses. One of these shows the Dejough transmitter in use with the anti-induction apparatus of Van Rysselberghe. This arrangement is intended for railway work, and meets a want long felt, namely, the installation of a number of telephones upon the same telegraph wire, so as to permit any office to talk to any other office. Another noticeable exhibit is the phonotelegraph of Renard Nothomb. This apparatus transmits telegraphic and telephonic messages under conditions which would be impossible in any other system. The currents induced are such that it is no longer necessary to take into consideration the length or, within limits, the insulation of the line. The wire may be of very small section, .001m. diameter, and may be carried along the damp ground, across small streams, and under roads. This instrument, whose compactness renders it very portable and easy to manage, is worthy the attention of the military authorities, since now, more than ever, field telegraphy and telephony have become of the first importance. Messrs. Mourlon also show one of the microphonic sounding boards, such as are in use at Theater de la Monnaie to transmit music telephonically to the Chalet Royal at Ostende and to the Palace at Laerken. It was on this occasion that songs and music were first sent some eighty miles over the lines without in any way disturbing the telegraph service.

FIG. 3.

Inter-State Telegraph Bill.

A Washington dispatch of September 3d says: A month ago the senate passed an Inter-State telegraph bill. It was thought that the majority in the house would take advantage of this and get the subject up for consideration, thereby bringing the whole subject of postal telegraphy to an issue. It was not believed that congress was yet ready to adopt a complete scheme of government telegraphy, but after the discussion of the matter it was pretty certain that the first step could be taken by the adoption of a measure putting the control of the telegraph business in the hands of the Inter-State Commerce commission. Congressman Laird of Nebraska tried to bring the question to a focus to-day by introducing a resolution reciting that in last March the committee on commerce had reported a bill for establishing a postal telegraph system, and that it is in the report submitted as a matter of fact that the people of this country are, as to their telegraphic facilities, in the hands of a monopoly that not only has the right to fix its charges arbitrarily but can crush competition wherever it encounters it, and can centralize within itself a tremendous power that can be used to oppress the people and to promote the purposes of those who control it; that to-day the Western Union Telegraph company, with its hundreds of thousands of miles of line, has by purchase, lease, and traffic contract submerged substantially every competing line in existence until 60,000,000 people are utterly and absolutely dependent upon it for the means of telegraphic facilities, now one of the necessities of civilization, and that this telegraph company, with all its immense franchises, is virtually in the grasp of one individual, who can run its stock up or down to suit his fancy, who shapes its destinies, and who has never had the slightest regard for public interests, private contracts, or vested rights when they interfere with him in his march to aggrandizement and to power. For these reasons Mr. Laird thinks it is the duty of congress to set apart a day to consider the subject

New England Electric Exchange.

In Henry B Cram's remarks on the New England Electric exchange before the National Electric Light convention, published on page 140, No. 10, Vol. III. WESTERN ELECTRICIAN, a meaning the opposite of the speaker's intention was conveyed by errors in punctuation. The sentence in line 17 of the third column and the following sentence should read: "In a general way the plan was simply this: A plan of licensing was adopted, as I have already stated; examiners were to be selected from men possessing theoretical and practical knowledge, and the applicants were to be examined and passed upon by those examiners. In order that the insurance people should be fully represented, and that there might in no event be any question of the action of the exchange, it was decided that the inspector of the insurance exchange should countersign the license certificate before it was finally issued and became a certificate."

Early History of Cable Laying.

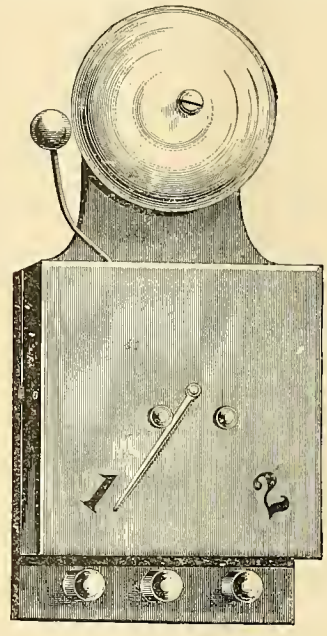
Owing to the war between rival companies the rate for cable messages to Europe got so low recently that the public lost sight of the fact that a great many millions of dollars are invested in the dual enterprise of communicating electrically with the old world and providing the sharks and other inhabitants of the deep with clothes lines and lightning rods combined, says the New York *World*. A combination of all the cable companies has been made again, and the rate advanced. In investigating the subject it was ascertained that few persons, even among those connected with the various electrical companies, knew that there was a cable laid across the Atlantic Ocean prior to 1866, and yet that was the third cable put down.

The first suggestion of the practicability of an Atlantic cable was made by Prof. Morse in 1843, nearly two years before his first telegraph line was in operation, and the first submarine cable known to have been laid was completed in September, 1851, and connected England and France. April 15, 1854, the New York, Newfoundland and London Telegraph company was incorporated, and on May 6th the first meeting of the board of directors was held and preparations were begun for laying a cable between America and Europe.

In July, 1856, soundings were made in the Atlantic for a cable route, and the next summer the work of laying it was begun, but on Aug. 10th the cable end was lost at sea and could not be recovered and spliced, and hence the first attempt proved a failure.

In the meantime, however, a second Atlantic cable company, called the Atlantic Telegraph company, had been formed, of which Cyrus W. Field of this city, was a prominent member, and he became the manager of the company before the work was completed. On April 24, 1857, the steamship Niagara sailed from New York to assist in laying this second cable, and August 15th the cable squadron, comprising the Niagara and the British naval vessels, the Gorgon and Indus, sailed from Queenstown and began the work, which was pursued until interrupted by winter and resumed again June 10, 1858. The end in mid-ocean was successfully grappled and spliced, but a few days later the cable parted again but was again spliced, and on August 5th the work was completed. On the 16th, the shore connections having been made, the president of the United States and the queen of England exchanged congratulations over the completion of the cable, and New York began preparations for one of the biggest celebrations known up to that time. This event took place on September 1st, and the account of it filled twenty-eight and a half columns of the *Herald* of the next day. The city and surrounding country went fairly wild over the accomplishment of the great undertaking, and put in two days and one night making it memorable. The city was overrun with visitors and the streets were described as containing "over half a million of jubilant people," and nearly every building was decorated. From the Battery to Union place, as it was called then, Broadway was so densely packed that the Seventh and Seventy-first regiments, acting as escort to a grand procession, could scarcely crowd their way through. There were services during the day in Trinity church, where Bishop Doane delivered an address, and there were services elsewhere and a grand reception to Mr. Field and the officers of the vessels at the Battery. The reception was given by the common council, and afterward the procession escorted the guests to the Crystal Palace, where congratulatory addresses were delivered and hundreds of telegrams received from other cities, among them being one from Roscoe Conkling, mayor of Utica.

During the festivities the next day the announcement was made that "a bug had got into the cable" and it was wisely concluded to postpone further rejoicing to celebrate the eviction of the "bug." It was never got out, however, and the cable was useless from that date, except as a tow-path for summer tourists of the finny tribe. Mr. Field and his associates, although sadly disappointed, were not entirely discouraged, but the war came on before they could get to work again, and the third Atlantic cable was not ready to lay until about the 1st of June, 1865. On July 22d the shore end was laid, and the next day the Great Eastern, which had failed to find any other field of usefulness, commenced paying out the cable. Experience gained from the two previous ventures proved valuable in the third enterprise, but even yet there was much to learn about ocean cable laying. Owing to the immense size of the Great Eastern the work could be done more perfectly, and as coil after coil of the cable was wound off the reels and dropped into the sea extreme care was taken to make the splices to the following sections as strong as the body of the cable was, but, nevertheless, on August 2d, the cable parted and much difficulty was experienced in grappling the ends and splicing them. As the cable was completed, section by section, tests were made through it to the shore. After a few months' delay the Great Eastern resumed work again in 1866, recovered an end which had been lost and completed the cable, which was opened for business July 29th, the tariff being fixed at £20, or $100 a message. Four days later the cable parted in mid-ocean and the Great Eastern again grappled the ends. Communication was restored September 8th, and the cable worked twelve years, having been abandoned in 1878. In the meantime, however, other cables



TWO-CALL INDICATING BELL.

had been laid, and the tariff was reduced first to £5 and later in 1870 to £3, and then cables began to multiply so fast that the rates got much lower.

The difficulties encountered in the first ventures have to some extent retarded all efforts to lay Atlantic cables, but nevertheless there are now twelve of them in operation, ten from North and two from South America. The capacity of the cables has been increased since 1880 by working them duplex, that is, making two circuits on each cable. All of them are not so worked, but six of the ten are, and the others can be when business requires it.

The cables are owned as follows: The Direct United States Cable company, one; Anglo-American company, four; American company or Western Union, two; French, one, and Commercial Cable company, two. All of these, except the Commercial cables, are in the pool and are practically tributary to the Western Union company. The Commercial is the only company that has a cable actually running into New York, the others all ending in Nova Scotia or the vicinity, although some of them have subcables to adjacent points in the United States. The Commercial company's main cables land at Cape Canso, N. S., crossing the ocean from Waterville, Ireland. From Cape Canso one cable is extended to Rockport, Mass., and thence by aerial cable to the city limits, whence it is run under ground to the office. The second cable is run by sea to Coney Island and underground from there to the office, the only place it is in the air being under the Brooklyn bridge. When this cable was first laid it ended in the cable house just east of the Oriental hotel at Manhattan Beach, and all telegrams over it had to be repeated there, but it was extended to the city, and now the apparatus may be seen just inside the first window south of the company's office in the Drexel building in Broad street.

Two-Call Indicating Bell.

The cut in connection shows a new style of two-call indicating bell, made by Partrick & Carter of Philadelphia. The principle is simple and the same as in their patent needle annunciator. The arrangement requires no adjustment and cannot get out of order even if the bell fails to ring. The pointer or needle always remains pointing to the last call; it requires no trip or set-back, as it automatically sets itself.

Lightning's Freaks.

In view of several peculiar instances of the effects of lightning mentioned in this journal recently, the following from the London *Electrical Review* is interesting: A few weeks ago a Reading clergyman described the experience of a man in his employ who received an electric shock during a rain storm, but which was not attended by thunder or visible lightning. Several other similar cases have been since described. First, there is an account in the *British Medical Journal* by Drs. Cook and Boulting of the injuries received by two sawyers on the Spaniards' farm at Hampstead. The man most injured, the elder of the two, was leaning against an oak tree. There was no rain nor any sign of a thunderstorm. The other was sitting on a block of wood 3 feet away, and two saws, 6½ feet long, were leaning against the fence about 2 feet from the trunk of the tree. The first man saw nothing and felt nothing; he was struck senseless instantaneously. The second heard a deafening thunder clap and felt stunned for some minutes, but had no sensation of pain. Then he discovered that his clothes were smoking and burning, although not ablaze. He then saw his companion lying senseless on the ground, quite still, as if dead, and his clothes partially torn from him. Having put out the fire in his clothes he crawled—he could not walk—to the road near and shouted for assistance, which soon arrived, and both men were conveyed to the infirmary, where, upon being roused, the elder man regained consciousness to a slight extent. Burns were found on the right side from the shoulder to the feet. The legs of the other man also had marks as of burns; both were in a state of collapse. After 11 days in the one case and 14 in the other, the men recovered. The doctors remark that it should not be forgotten that dangerous return discharges from the earth to the atmosphere may take place at a considerable distance from an atmospheric storm. Another case, this time a fatal one, of a lightning stroke without the visible appearance of lightning, comes from France. At Puy-de-Forche, in the Department of the Dordogne, during a thunderstorm, a girl was seen to walk toward a tree and clasp it. No lightning was seen, but in a moment the girl fell backward, and when examined was found to be quite dead, with appearances which indicated that she had been killed by an electric stroke. A second fatal case is related to have taken place in the Island of Fariguana. During a rainstorm a lineman observed that a lightning rod was fused at a point in contact with the building to which it was attached. He tapped the ground end of the rod with a hammer and immediately fell dead. The hammer had two metal strips reaching from the head down the handle. It is suggested that as the building stood on a rock and the lightning rod was grounded in a deep well, there may have been considerable difference of potential between the place where the man was standing and the grounded lightning rod. This case again goes to show that lightning rods should not be insulated from the buildings to which they are attached. All these instances prove one thing clearly and that is that the danger from lightning is even of more subtle character than is generally supposed, for it may strike down its victims without warning or manifestation.

New Engine of War.

A Paris cable dispatch gives the following description of an invention to demolish ironclads: A new submarine boat intended to revolutionize naval warfare is to be launched at Toulon September 15. It is designed by M. Ramazoti, a government engineer. She is so constructed as to be able to dive completely beneath the keel of the largest ironclad and by means of special apparatus fasten explosive cartridges to the sides of the enemy's vessel, and is enabled to maintain communication with the explosive cartridges so fixed by means of a steel wire by which the cartridges can be exploded by electricity. This new engine of destruction combines all the requisite conditions of speed, steering capacity, submersion, immersion and habitability. The vessel is seventeen meters long between perpendiculars and 180 meters beam. She is enabled to dive under water to any given depth by means of a series of reservoirs that receive water in variable quantities. Reservoirs of compressed air allow air for breathing purposes to be renewed at will. Horizontal steering is effected by an ordinary rudder. Vertical steering is effected by a doubled rudder working on double hinges attached to the sides of the stern. A little cupola thirty-five centimeters in diameter is built on the bow. It is in this cupola, provided with glass windows, that the officer in command directs the vessel. The entire crew is one officer, two engineers and a sailor. The motive power consists of Kreb's electric machine of fifty-horse power. Other engines are provided with compressed air apparatus. Preparations are already being made for launching this formidable little vessel, and a railway is now being laid to convey her from the arsenal of Mourillon to the sea.

The Babyhood of Telegraphy.

BERNARD O'CONNOR AND PROF. MORSE.

BY JAMES D. REID.

Part I.

Toward the end of May last a lengthy but very readable article appeared in the Chicago *Inter-Ocean*, which was quite generally copied, giving the result of an interview with Bernard O'Connor of Fort Wayne, Ind., one of the pioneer telegraph builders, now a venerable and wealthy man. As he has used my name in his somewhat singular narration, I have thought it due to the honest fame of dead and dear friends to correct several obvious errors. I do this more readily because my intimacy with all the parties was, perhaps, greater than that of almost any one of them with each other, and because I had very peculiar opportunities for knowing the true inwardness of almost all that was done in those early days. I am glad also to come once more into contact, not to say in conflict, with Bernard O'Connor, of whom I have not heard since he finished the building of the lines to St. Louis in 1847, and of whom I retain a very pleasant memory and regard.

In this interview Mr. O'Connor is made to say that the first lines built westward from Harrisburg to Pittsburgh were a continuation of the government line from Washington to Baltimore. This is an error rather than an incorrectness. The lines which were first started west were commenced at Lancaster, Pa., in September, 1845, and were built under a well-known contract with Henry O'Reilly, who died in Rochester, N. Y., a few years ago. under whom, and with myself as superintendent, Mr. O'Connor and John J. O'Reilly prosecuted the work. These lines had no organic connection with the lines between Washington, Philadelphia and New York, although for some time I was the superintendent of both.

Sunday Work.—It is certainly true that after the completion of certain sections of line as the work proceeded westward, delay occurred in getting them to work, corresponding remarkably with the Sunday work performed upon them. It was a very singular truth, and caused much remark. Without undertaking to account for it, and being then as always opposed to unnecessary Sunday work and rather pleased to prevent it, I took no pains to disturb the belief entertained that the loss of time in securing the proper working of the newly erected wires was the result of Sabbath violation. Of their own accord the builders established that relation. It caused the stoppage, for a time at least, of all outside Sunday work.

The narration of the interview continues as follows:

"*The Earth as a Conductor.*—Here a discovery was made that greatly reduced the expense of construction. The three men, J. D. Reid, Henry O'Reilly and B. O'Connor, had a conference at Lancaster, and all three came to the conclusion that as it was conceded that the discharge of the positive pole of the battery did return to the negative pole the ground could be used to complete the circuit. The line was pushed on to Harrisburg and only one wire was used. The experiment was tried, and to the great joy of the three men, worked at once. Mr. O'Connor says that Mr. O'Reilly, before the single wire had been put up, wrote to Prof. Morse and told him they were going to make the experiment, stating that he believed it would work. The professor replied impertinently, and told him he had better let scientific matters alone and attend to his own business. After it had been discovered to work successfully, Mr. O'Reilly again wrote to Professor Morse, and told him what they had accomplished. Mr. O'Connor states that Professor Morse then published an article in the Baltimore *Clipper*, in which he stated that, in consequence of a wire breaking, it had been discovered that the ground could be used as a conductor to complete a circuit."

The credit given to J. D. Reid, Henry O'Reilly and Bernard O'Connor as to the discovery of the curious fact that the earth could be used as a "return wire" without using a second wire as had been supposed essential, I would be very glad to acknowledge as correct, but it is utterly baseless except perhaps in the proof we occasionally had of the fact, and which, no doubt, induced some original reflections. None of us were "up" in electrical knowledge at that time, and the little I myself then possessed gave me much consequence, and caused me to be spoken of as "professor." The truth is that the knowledge of the earth as a conductor is due primarily to the researches of Dr. Watson of England in or about 1747, while experimenting with the Leyden jar. In July, 1747, he conveyed the electric shock across the river Thames, at Westminster bridge, and a few days after he caused it to make a circuit of two miles at the New River at Stoke-Newington. A circuit of four miles, two of wire and two of dry ground, was completed in August of the same year, and in the same month he satisfied himself and his friends that the velocity of electricity in passing through a wire 12,276 feet, was instantaneous. It is somewhat curious to know that this same Dr. Watson was the first to demonstrate by some very beautiful experiments the passage of electricity through a vacuum by use of an exhausted tube three feet in length. This was just previous to the famous experiments of Dr. Franklin now so familiar to the world. So this trio of worthy men were not at least original discoverers, although at times much impressed with the fact by shocks of electricity suffered in their persons, as the work of erecting the wire proceeded.

I remember very well that on one sultry day, as the men were partaking of their mid-day meal, a venturesome bull calf approached the embankment of the Lancaster and Harrisburg railroad, and with open eyes and an observant head studied the progress of the dinner. He stood near a pole upon which the wire had just been erected, and the end of which hung within a few feet of the ground. This finally attracted the young quadruped's attention, and after gazing at it a moment he put out his tongue to prove its materiality. Just then a cloud overhead loaded the wire with a comfortable charge of Pennsylvania lightning, which at once developed itself in the calf, who, uttering a loud shout of surprise, disappeared—tail erect and stiff—over the adjoining fence. He had illustrated in a very happy way to us the tendency of the electric current to seek the earth even if it had to pass through the integuments of a bull calf's viscera.

I remember also amusing the men by sending a message to Harrisburg by using the point of a wire to write the Morse character on the surface of the water of the canal, and which was correctly received on the register at Harrisburg.

In the then comparative ignorance of electric matters on the part of the wisest of us, this may have been properly regarded as a great achievement, and undoubtedly secured some friendly glory in which Mr. O'Connor with his natural goodness joined, and perhaps still retains. Time, however, has broadened our vision, and made us more modest.

(*To be continued.*)

The Defunct Great Western Telegraph Company.

An important suit has been commenced in the Circuit court in Chicago, which is interesting to 2,859 stockholders in the defunct Great Western Telegraph company. It is in the form of a chancery bill. The complainants are thirty-four of the stockholders, and they come into court to escape stock liability for the $390,000 of debts which were found to be owing by the Great Western Telegraph company when it was wound up by the Circuit court in 1870. They are headed by Eugene C. Bates and William Miles. They were the original subscribers for from one to 100 shares of the capital stock of $3,000,000 of the Great Western Telegraph company. Telegraph lines were laid for 1,500 miles in 1868 by Selah Reeve of Cleveland, and when he finished the work at a cost of $405,000, the company was found to be insolvent. Jeremiah Terwilliger, one of the stockholders, had a receiver appointed, and the company's property was sold for $15,000, leaving $390,000 due to creditors. On the representation of the receiver, the court ordered the 2,859 stockholders to pay up the unpaid stock for which they had subscribed. Some did so, and others did not. Among those who refused to pay are Bates and the thirty-three other complainants. The ground of their refusal is that they are not liable on the stock. They say that they bought the stock in 1867 of Selah Reeve, and not of the company. Of the 120,000 shares of stock, Reeve subscribed for 117,000 shares, which he conveyed to the company to sell at $25 per share. The receiver represented to the court that the actual owner of the stock was the Great Western company, whereas it was merely Reeve's agent for the sale of the stock. Reeve and other directors are alleged to have entered into an unlawful combination to defraud the stockholders. It is alleged that the receiver carried his misrepresentation into a suit brought against Franklin D. Gray, a stockholder, of Lake county, and on his wrongful statement of facts procured a decision by the Illinois Supreme court against Gray. This decision, secured on incorrect premises was held up as a precedent to the other stockholders and 1,000 of them were sued, and the receiver, Elias R. Bowen, attempted to coerce them into a settlement. The complainants ask that the decree making them liable for nearly $400,000 be vacated and set aside on the ground of its procurement by the receiver's fraud.

Electric Light vs. Gas.

The Rochester *Morning Herald* quotes a paragraph from the WESTERN ELECTRICIAN in which the wisdom of substituting gas for electricity in the court house in Rochester was questioned. The *Herald* adds: "We don't think it was economy, except as it may serve notice on the companies supplying light that the county will not be imposed on if any attempt is made to charge exorbitant rates or to reduce the guaranteed candle power. Gas is valuable for illuminating purposes and will remain in use for an indefinite period of time, no doubt; but when the incandescent electric light can be secured on nearly equal terms it is in several respects incomparably superior to gas or any other illuminating agent. The advantage of the incandescent lamp over gas is especially apparent in that the former does not vitiate the air of an apartment. The carbonized filament that is raised to incandescence and furnishes the light is inclosed in an airtight glass bulb and therefore, though a hundred of them be burning in a closed room, no oxygen is taken from the apartment and the air of the room remains as pure as if no lamps were burning. It is estimated, we believe, that a single gas jet, speaking generally, cousumes more oxygen than a human being. The difference in the purity of the atmosphere of a room, the windows and doors of which are kept closed as in cold weather, is therefore almost immeasurably in favor of the incandescent light. Where there are several occupants of such a room, as in the various apartments of the court house in this city, their health as well as the cost of the several systems of lighting respectively should be considered."

A Telephonic Legal Case.

A case of interest and one possessing some new features, has arisen at Nashville, Tenn., between Denneday & Maddux, contractors for the Vanderbilt law school building and the Cumberland Telephone & Telegraph company. An injunction was asked by the telephone company to restrain the contractors from cutting or removing their wires in front of the foundations of this building. The contractors answer the bill of injunction and allege that not only is it absolutely impossible for them to raise the large blocks of stone to be used in the structure if the wires are allowed to remain, but their attorneys have discovered in the bill of privileges granting the telephone company that the right of way which the company claims was, as a matter of fact, never granted. The contractors declare that the only proceeding bearing on this question occurred in September, 1882, when the Cumberland Telephone & Telegraph company sent a petition to the mayor and city council asking that the right of way be granted it through and over certain streets mentioned in said petition. The board of aldermen and common council verbally agreed to said petition and the mayor indorsed his approval on the original petition of the telephone company. Defendants now assert that no bill was introduced, and no ordinance passed relating to said right of way, not even a resolution. Defendants claim that the action of the city council in this matter was informal, null and void, conveying no rights to the telephone company, and that in consequence the company is a trespasser on the streets of Nashville. The case will be called for argument on a motion to dissolve the injunction.

The Long Distance Telephone in the West.

Among the corporations recently chartered in Illinois is the American Telephone & Telegraph company, organized for the purpose of building and operating telephone lines from Chicago to other cities. Work on the new line has been commenced between here and Milwaukee. This distance is to have a line of forty-foot poles, independent of any other telegraph or telephone line, and ten wires will be strung at once, though it is expected that a larger number will be required if the enterprise proves as successful as is anticipated. Only copper wires, manufactured and strung after the most improved and modern plans, will be used. Long distance telephone service has not been successful so far as Chicago is concerned, chiefly, if not solely, for the reason that the wires which connected this city with Kenosha, Racine, Milwaukee, and other places were strung on poles which at the same time carried railroad and other telegraph wires. The rates to be charged have not yet been decided upon.

In No. 9, Vol III. of the WESTERN ELECTRICIAN were shown three indicator diagrams taken from a Woodbury automatic high speed engine in the Edison central station at Rochester, N. Y. These diagrams were reduced to make the dimensions of the cuts conform to the measure of the column. They were published to show their generally fine characteristics rather than to reproduce precisely a record of the engine's performance; and while the scale is an essential element in considering indicator diagrams, those published will not, of course, stand the application of the planimeter inasmuch as such an application would be unfair to the engine.

After a competition lasting for five years, the committee of the French chamber and senate have decided to award the Volta prize of 50,000 francs to M. Gramme, for the improvements made by him in the construction of dynamo-electric machines.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

	PAGE
Automatic Medical Battery, Illustrated	155
Fire in the Station of the Chicago Arc Light and Power Company	155
Dental Electrics	155, 156
New Dynamic Incandescent Switch, Illustrated	156
Constitution of the Electric Light Association	156
Perforated Leather Belting, Illustrated	156
Chicago Telephone Matters	156
Earth for a Lightning Conductor	157
Paillard's Non-Magnetic Balances, Illustrated	157
The Van Rysselberghe System at Brussels	157
Inter-State Telegraph Bill	157
New England Electric Exchange	157
Early History of Cable Laying	158
Two-Call Indicating Bell, Illustrated	158
Lightning's Freaks	158
New Engine of War	158
The Babyhood of Telegraphy—Bernard O'Connor and Prof. Morse—by James D. Reid. Part I	159
The Defunct Great Western Telegraph Company	159
Electric Light vs. Gas	159
A Telephonic Legal Case	159
Long Distance Telephone in the West	159
Editorial	160

DEPARTMENTS.

Correspondence	161, 162, 163
The Electric Light	163
The Electric Motor	164
The Telephone	164
The Telegraph	164
Electrical Patents	164, 165, 166

PROF. J. P. BARRETT, city electrician of Chicago, is an ardent admirer of the underground system. He says the Chicago service is much more satisfactory since the wires were buried. He is quoted as saying: "The underground system will surely come into use all over the country. Public protection, public convenience and public policy all demand the change."

A TRIAL trip was made last week of one of the storage battery cars to be run on the Fourth avenue railway in New York. According to the report the experimental trip was successful in all respects. It is estimated that the expense of operating the new system will be about that of horse traction; but it is thought that the indirect saving will be considerable. The subsequent trial of cars will be watched with interest.

THE publication of an extended interview, in a Chicago newspaper, with Bernard O'Connor, now a resident of Fort Wayne, Ind., but one of the pioneer telegraph line builders, has afforded James D. Reid, also a pioneer in telegraphy and an author of note, an opportunity to draw from his rich store of historical knowledge in correcting several errors, and further to weave into the thread of his narrative several deeply interesting reminiscences.

Mr. Reid's close intimacy with Professor Morse and the prominent pioneer constructors of American telegraph lines, enables him to speak with authority.

It is a matter for regret that Mr. Reid's answer cannot be published in its entirety in one issue, but we can assure our readers that "The Babyhood of Telegraphy" will amply repay close perusal.

THE New York *Sun* is usually correct in its use of terms even though they be of a technical character. Once in a while it makes a slip, especially when it employs the phraseology of the electrician. In a recent editorial it advises the democratic national committee to "employ every ohm of electrical energy incorporate in your campaign committee to the canvass in the doubtful states."

THE extension of electric lighting in the south is remarkable, and the favor which is extended to all electrical companies rather alarms the gas companies. At the recent meeting of the Southwestern Gas association at Galveston, President F. Beck said: "Electrical machinery will be more and more in demand. For us the question is: Shall it be in competing hands, or shall it be used as a branch of establishments that have made it their business for years to furnish light, heat and power?" Mr. Beck said the gas companies were able to compete with electric light, but he added: "We all represent small gas works, and as a division of business between two lighting companies, even at fair rates, would not be sufficient to secure for either a commensurate compensation on the capital invested, what is more natural than that the applications for franchises to erect electrical plants in towns and cities, should more or less alarm the managers of existing gas works; but they feel the necessity of exchanging notes with others engaged in the profession, so as to be able to select the most appropriate additions to their plants, to improve the works under their charge, and to gain a knowledge of all appliances used at present for furnishing, at low rates, light, heat and power; also, to select the best market for the purchase of raw material and machinery used."

A MEETING of the board of managers of the Chicago Electric club has been called for Thursday evening of the current week to hear reports of committees and to take some action looking toward an awakening of a new interest in the club. The meeting of the board of managers is preliminary to a general meeting of the club Monday or Tuesday evening of next week, when, it is to be hoped, there will be a large attendance of the members in order to lay out the work of the winter.

The Chicago Electric club has a history of which it may well be proud. Its scientific work of the year as exemplified in the numerous able papers covering a wide range of subjects presented by the members, is on record. Numerous allusions in domestic and foreign electrical journals to these papers evince the care with which they have been perused at home and abroad, and each member of the organization can take pride in the fact that he is connected with a club that has so excellent a standing in both America and Europe.

The founders of the club, after a careful review of the field concluded, however, that a club organized on a distinctively scientific basis could not be supported in Chicago, and therefore resolved to lay the foundations upon a combined scientific and social basis. In carrying out the plan, rooms contiguous to a restaurant were secured, and they were handsomely furnished. Fault has been found in some cases with the service of the cafe and not a few members have expressed a wish to make a change.

The club at the annual election in early summer selected as a presiding officer S. A. Barton, and also made a wise choice in the board of managers. Both president and management have determined to reinvigorate the club and place it on a better footing than it has ever had. The members of the club should not be outdone. One man or sixteen men united can accomplish much, but the sum total of the results of their efforts can be only a fraction of the results that may be easily accomplished by all the members combined. The summer is over and vacations are ended. The cool brisk weather of fall is at hand. Let each member of the club then extend a mental promise to president and management to assist to the best of his ability in carrying out plans that may be decided upon as the wisest and best for strengthening the club in every particular. Combined effort will produce great results and the club will have a wider reputation, be stronger in every way and take a position both among clubs of similar class and other Chicago clubs distinctively its own.

It should not be forgotten that the next convention of the National Electric Light association will be held in Chicago. The members will be guests to a large extent of the Chicago Electric club, and the club should see to it that it is prepared to extend to its guests that hospitality proverbial of Chicago.

THE Chicago city council again has before it the telephone question. The knotty problem has been taken up at the point where it was dropped when the aldermen adjourned for the summer vacation. Unquestionably strong pressure has been brought to bear upon the body to induce it to reduce the telephone rentals from $125 to $75 per annum. One petition bearing the names of 3,000 subscribers was recently presented to the committee on licenses urging that action be taken. During the summer a petition was circulated among merchants. They were asked in addition to signing their petition to sign an agreement to pay $5 or $10 in case the prayer of the petition was granted. It was hinted that several aldermen were interested in this collection, but no direct statements have been made concerning the story.

At the first meeting of the council a resolution was presented directing the law department to take steps to secure the vacating of the injunction which restrained the city from interfering with the wires of the telephone company. An ordinance was introduced reducing the rental to $75. Both measures were referred. The reference was commendable, especially as the law department has made no report on the question of the city's right to adjust the rates. The corporation counsel when asked the question, declined to express an opinion.

It is to be hoped that no hasty, inconsiderate action will be taken. The aldermen should not overlook the fact that the telephone is a necessity and that any unjustified interference with the service will work to the disadvantage of a very large number of citizens.

MAYOR HEWITT, of New York, possesses the high regard of a large number of electric light men. His address before the recent convention commended itself to all the members of the association for its hard common sense and for its just appreciation of the situation in the electric lighting field. His honor has written a sensible reply to A. B. Cornell's letter. He says: "As to the controversy between you and the National Electric Light association, which recently met in this city, I do not see that I am concerned. I am convinced, however, that in proportion to the service rendered there is no more danger from the electric currents than there is from the ordinary operations of society as carried on by steam and horse power. These are all regulated by law, and so are the electric currents and their mode of transmission through cities. So far from there being any deficiency of law on the subject in this city, I think we are suffering at present from too much of it." Mayor Hewitt's observations in the paragraph quoted will meet a ready response in the hearts of officers of many an electric light company. When so many foolish statements are made concerning the dangers of electric lighting the importance of sensible utterances coming from a man like Abram Hewitt, can hardly be over-estimated. In his statement that the public is suffering from too much law, Mayor Hewitt expresses a truth which has a far wider application than its reference to electric lighting. An eastern newspaper says: "Cranky philosophers and whimsical philanthropists are all the time spying out what seems to them objectionable practices on the part of their neighbors in the management of their business, the pursuit of their pleasures, the disciplining of their households, and the general conduct of their lives and affairs. Accordingly, they rush to Albany and induce the rural legislators to pass laws which make the meddlers substantially moral censors of the community and regulators of its manner of life."

CORRESPONDENCE

St. Paul, Minn.

ST. PAUL, Sept. 13.—The incandescent installation recently put into the new office building of the St. Paul, Minneapolis & Manitoba Railway company by the Mather company was given a trial run a few days since. An Ide engine and two 300 light dynamos are in place, with neat walnut switch board, on which is mounted the various indicating and controlling instruments. The building is wired in a sightly and convenient manner, and credit is due F. C. Turner, Minneapolis agent of the Mather company, for the general excellence of the work

The Economy Steam Heat company, through the efforts of Russell Baker, electrician, is rapidly gaining favor and becoming a strong competitor of the older electric light companies. Its clientage for both arc and incandescent lighting numbers some of the best retail establishments in St. Paul, and the demand has not yet been satisfied. The summer lull was taken advantage of by the Economy Steam Heat company to reconstruct its plant. A new Russell automatic high speed engine was put in and the dynamo room rearranged and greatly improved. Many additional changes are contemplated, which, if carried out, will improve the already good service furnished

The Gas company's plant under the handling of Walter E. Snow, electrician, is as handsome an installation as can be found. The service is excellent and, as a result, the business is constantly increasing. About 1,000 incandescent lights are now in use and the arc business is more than holding its own.

The business of the local Edison company is exceptionally good, more lights than ever before at this season of the year are being run, and a large force of men is constantly busy wiring for more lights. The service is better than ever, and the business community of St. Paul is not slow to appreciate a good thing.

St. Paul is noted for the magnificence of her street illuminations as regards extent, elegance of design and artistic commingling of colors. The city officials appropriated $8,000 for street illuminating purposes during the state fair September 10–15. The illumination eclipses anything heretofore done either here or anywhere else, not excepting St. Louis, the supposed paragon of such displays. The arches, trees, crescents and grand corner pieces modeled into numberless groupings of geometrical shapes and forms, are beyond what has before been attempted in this line. The greatest feature of the display is the coloring of the globes and the combination of colors. In the past simply plain globes of three colors have been used, white, red and blue, with white predominating. For the present illumination cut glass globes are used with coloring of orange, canary, blue, green, white, ruby and amber, the latter color predominating. The sight is well worth seeing. The local Edison company prepared several large pieces in ornamental shapes, which have proved noteworthy features of the illumination. W.

Kansas City, Mo.

KANSAS CITY, Mo., Sept. 14.—Work is being pushed on the new plant of the Edison Electric Light company. The foundations of the building are broad, massive and deep. They are put in to stay, and are sufficient for a heavy seven or eight-story structure.

The Inter State company will be in new offices by the 15th, in the Keith & Perry building, in the basement of which the new storage and incandescent light station will be located. This Keith & Perry building is one of the finest and handsomest buildings in the city, is opposite the post office and is practically at the "junction," the very heart of the city, so the Inter-State has a convenient location for business.

The Western Electric Construction company will also move into new quarters soon, and will probably occupy rooms in the Electrical exchange, the National Bank of Kansas City building, at the southeast corner of Fifth and Delaware streets. This is a hobby of Mr. Weeks, the manager of the Kansas City Electric Light company, and when he has a hobby, he generally rides it to victory. The Electrical exchange was occupied at first by only the Kansas City Electric Light company. Now, in addition, are the Electrical Supply company of Chicago, the Southwestern Electrical Supply company, and the Thomson-Houston agency.

The Southwestern Electrical Supply company finds the electric motor popular. During the last week the company sold one of 2 horse power to a laundry, and one of 1 horse power to a printing office. This company has now secured the sole agency for the southwest of W. L. Libbey & Son company's globes, shades, etc.

C. H. Cone, the agent of the Electrical Supply company of Chicago, has been quite seriously indisposed for several days, but is now recovering.

The Western Union Telegraph company has just placed a new electro pneumatic tube in its office for the transmission of messages to the operating room. The apparatus works like a charm, and when a tall Irishman handed Day Clerk Campbell a message the other day, he was surprised to see it whisked out of sight as if by magic.

The Missouri & Kansas Telephone company has recently established stations at Pleasant Hill and Harrisonville, Mo. Work is progressing rapidly on the new line between here and Topeka, and the company expects to have it in working order within a week or so. The company has recently made an important discovery, viz., how to accomplish in an hour and a half what has formerly required a month—the testing of the resistance on all its wires in the city.

The storage battery has arrived for the central station plant of the Inter-State Electric Light company.

Aldermen Lee and Finlay of the special committee appointed some two months ago to investigate the telephone rates of this and other cities with a view to making a comparison, and to learn whether those charged by the Kansas City company were exorbitant, have received about eighty replies to their inquiries addressed to other cities for rates. The information is condensed in the foregoing table. A.

City.	Rates to Business Houses	Residences	No. of Telephone	Free Instruments.	Miscellaneous.
Washington, D. C.	$60 to $100	$60 to $72	1,500		Instruments for city use, $15 annually.
Mobile, Ala.	$64 to $84	$40 to $60	209		$100 annual license and regular city tax.
Montgomery, Ala.	$60	$45	200		$200 annual license; $30 annual tax.
Little Rock, Ark.	$60	$48	390	6 or 7 to city.	State and County tax and regular assessments as other firms.
San Francisco, Cal.	$5 monthly and 5 cents for each time telephone is used.	$5 monthly.			Two per cent. tax on assessed valuation of $37,150.
Sacramento, Cal	$4 monthly and 2 cents for each time telephone is used.	$4 monthly and 2 cents for each time telephone is used.	250		Two per cent. tax on assessed valuation of $8,000.
Meriden, Conn.	$50	$40	235		
Hartford, Conn.	$90	$50			City instruments $10.
Denver, Col.	$60	$72	1,035		City instruments $48.
Atlanta, Ga.	$64 to $84	$40 to $70	960		City pays half rates for ten instruments; license, $200.
Augusta, Ga.	$60 to $64	$44 to $50	225	1 to city.	Pays $250 tax.
Quincy, Ill.	$48	$48	500	City office and fire department.	
Ft. Wayne, Ind.	$78	$66	240		City instruments $250 a month; $50 annual license. Coupon tickets avoid $3 legal monthly rate.
Indianapolis, Ind.	Not less than $60	Not less than $60			No annual charge on account of $3 a month law.
Leavenworth, Kan.	$50	$36	400	1 to city.	Pays taxes.
Louisville, Ky.	$60	$60	1,500		Pays taxes.
New Orleans, La.	$50 to $96	$50 to $96		Fire alarm, police call, city offices	Pays $1,062 taxes.
Jackson, Miss.	$54	$54	55		Tax, $37.50
Lynn, Mass	$50 to $60	$40 to $50	600		Pays taxes on $5,000.
Portland, Me.	$50 on line, $75 on special	$40	760		City gives half rates.
Detroit, Mich.	$72	$50	2,900	Police department.	Twenty to twenty-five per cent. reduction in rates to city on tops of poles reserved for fire alarm system.
Grand Rapids, Mich.	$50 to $60	$40 to $50	1,050		
Rome, Ga.	$64 to $74	$50 to $60	96		Poles free for fire alarm system.
Jackson, Mich.	$48	$34 to $40	320		Poles free for city use.
Lansing, Mich.	$48	$40	175	Night fire alarm and 3 instruments.	
Duluth, Minn.	$50	$50	250		
Minneapolis, Minn.	$40 to $120	$40 to $120	2,500		Reduction being agitated.
St. Joseph, Mo.	$50	$50	800	Fire department.	City instruments half rate.
St Louis, Mo	$50	$50			Involved in litigat on.
Vicksburg, Miss.	$48	$38	180	6 to city.	Ten years' tax exemption.
Elizabeth, N. J.	Direct wire, one mile, $60; two miles, $75; circuit wire, $50 to $60		138	City telephone.	Charge made for fire alarm.
Jersey City, N. J.	$90	$60	586	Fire and police department.	
Trenton, N. J.	$60 to $66	$60 to $66	350	Police department.	
Albany, N. Y.	$51	$51	1,350		
Elmira, N. Y.	$48 to $60	$48 to $60		3 to city.	
New York City.	Office, $12.50 monthly.	$6 monthly and upward.			
Syracuse, N. Y.	$48 annually for 2 miles; $12 added for each added half mile.		900		
Poughkeepsie, N Y	$42	$42			
Omaha, Neb.	$5 monthly for a half mile; 50 cents for additional quarter mile.		1,415		Twenty per cent. discount from regular rates to city and county.
Manchester, N. H.	$4.17 monthly.	$3.33 monthly	253		
Wilmington, N. C.	$46	$60	115		$110 taxes.
Columbus, O.	$60 for ½-mile; $6 for added ¼-mile.	$48 for ¼ mile; $6 for added ¼ mile.	1,100		Special rates to city.
Dayton, O.	$48	$48	700	City instruments.	
Sandusky, O	$48	$36	400		
Toledo, O.	$60 for ½-mile.	$42 for ½ mile.	1,200		City rates $15.
Portland, Ore.	$5 monthly and 5 cents for each time used.	$5 monthly.	500	5 to city.	
Easton, Pa.	$50	$50	119	3 to city.	Company keeps fire alarm in repair free, but city pays for material.
Harrisburg, Pa.	$48	$36	230		
Pittsburg, Pa.	$84 up	$60 up	200	Fire department.	Tax of 1 mill on gross receipts.
Philadelphia.	$120	$100	7,836	City and county.	License of $2.50 for each mile of wire; $1 for each pole; 50 cents for each attachment to city poles.
Providence, R. I.	$42 to $60	$30 to $48	2,300	3 to city.	Taxed 1 per cent. on gross receipts.
Columbia, S. C	$60	$40	51		Attempted reduction failed.
Memphis, Tenn.	$50 up	$50 up	1,200	Fire department.	
Dallas, Tex.	$60	$48	431		City instruments $3 monthly.
Houston, Tex.	$60	$60	250		City instruments $18.
Richmond, Va.	$60 for ½ mile; $5 for added ¼ mile	$40 for ¼ mile, $5 for added ¼ mile.	693	2 to city.	Twenty-one to city for $10 a year less than the regular rates. Pays $300 for annual license.
Salt Lake City, Utah	$60	$60; when subscriber has one in business place also, $50.	450	5 to city.	Furnishes fire alarm.
Milwaukee, Wis.	$60 to $130	$12 to $60	2,060	5 to city.	Pays one-half per cent of gross receipts into city treasury.

KANSAS CITY, Mo., Sept. 15.—H. W. Smith of St Louis and Geo. T. Hewes of Kansas City have invented an electric signal apparatus, which is intended to dispense with the watchmen at street crossings of the cable road, both day and night. Your correspondent has seen several of the apparatuses and their usefulness has been practically demonstrated. By means of a switch which extends across the track of the grip, inside the conduit, an electric bell in a prominent position on one of the four corners of the street crossing is caused to ring. At the same time an automatic gas lighter lights the gas and displays a red light which also displays a notice to "look out for the grip car when the bell rings." The apparatus can be so adjusted as to light the gas and ring the bell for any length of time desired. The Metropolitan Cable Railway company of Kansas City through E. J. Lawless, general superintendent, has decided to adopt this system of signals. Where a double track crosses a double track, there is a double lamp, that is, two lamps, one over the other, and each is of a different color; a car going either north or south when within one hundred feet of the crossing causes the bell to ring and a red light to be shown. A car going east or west causes the bell to ring and a blue light to be displayed. This also signifies to the gripman that either he or a car on the crossing has the right of way. This double light is also valuable to passengers as it indicates the color of the car which is approaching and he is thereby enabled to increase his speed and reach the crossing in time to catch the car desired. This apparatus can be maintained at an expense not to exceed $25 per year. This signal system will also be valuable at curves where watchmen are constantly on duty. A recording attachment shows every time the bell rings. This will prove conclusively in cases of litigation following accidents that the person was negligent in attempting to make the crossing after he had been notified that a car was approaching. The manner of furnishing this system to cable roads has been decided upon The exclusive privilege of using the system will be sold outright and each road can use as many signals as desired.

The Kansas City Electrical works have just finished wiring the palatial residences of W. C. Scarritt, of Gladstone Heights, and A. J. Baker, of Hyde Park, for

burglar alarm, automatic gas lighting and electric lighting. These houses are wired for the Edison system, and light will be supplied by the Edison Electric Light & Power company as soon as their residence circuits are built.

Prominent among the August sales of the Thomson-Houston Electric company, of this city, C. S. Rusling, agent, were four 50-light arc machines to the National Exposition company, and an incandescent plant of 1,500 lights' capacity to be installed at Wichita, Kan.

The latter part of last May a franchise was granted to Freidburg & Ingram for the erection and equipment of an arc plant. They were also given a contract by the city of Kansas, Kan., for 100 arc lights for street lighting for a period of twenty years, the rates to be paid by the city being $12 per lamp per month for the first two years and $11 dollars per lamp per month thereafter, until the expiration of the contract. Since the granting of the franchise trouble has arisen, caused by the lack of finances on the part of one of the gentlemen. Your correspondent understands that a local company made a generous offer for the franchise, which would have been accepted by one of the owners had not the moneyed partner enjoined him from selling his interest. The matter is still in the courts, but an early settlement is looked for, so that Kansas City, Kan., need not be in the dark for a much longer period.

The American Electric Light company of this city, has lately received two 50-light dynamos. This company is constantly increasing its plant, and looks forward to a large fall business. D.

New York Notes.

NEW YORK, Sept. 15.—The interest exhibited at the recent electric light convention in S. S. Leonard's practical paper on petroleum fuel brings the subject prominently before all who are interested in steam power. It is now said that a German chemist has succeeded in solidifying petroleum for such use which will facilitate its handling and transportation. In this shape it burns freely, leaving but 2 per cent. ash. A prominent mechanical engineer of this city, upon hearing the foregoing statement, said he had recently completed tests of a certain grade of coal for an electric light and power company of this city which gave but 4 per cent. ash. He hopes to be at liberty soon to publish all the facts. He also added that the general use of petroleum as fuel would be likely to increase the price on account of the limited supply.

Mayor Hewitt has resumed the reins of office at city hall and has replied as follows to the letter of ex-Gov. A. B. Cornell, whose letter was read on the last day of the electric light convention.

"I infer from your letter of the 10th inst., which I have received that you misunderstood my phrase that it was premature to discuss the subject of legislation. I do not think any discussion affecting the public interest is premature. All that I meant was that, as the legislature did not meet until January, any discussion between you and me on the subject could not lead to any immediate action. As to the controversy between you and the National Electric Light association, which recently met in this city, I do not see that I am concerned. I am convinced, however, that in proportion to the service rendered there is no more danger from the electric currents than there is from the ordinary operations of society as carried on by steam and horse power. These are all regulated by law, and so are the electric currents and their mode of transmission through cities. So far from there being any deficiency of law on the subject in this city, I think we are suffering at present from too much of it."

Erastus Wiman said at the Staten Island dinner to the telephone visitors that it was hard for him to keep still under such a call as he then heard. He has now been speaking into a phonograph to be repeated by a duplicate instrument at the Toronto exhibition. The speech was allowed to escape on the 12th and proved to be a series of short addresses, two of which were in favor of unrestricted commerce.

Frederic E. Beardslee, a graduate of the Rensselaer Polytechnic Institute at Troy, committed suicide in this city Sept. 7th. He has been engaged for some time assisting Robert D. Radcliffe in perfecting an autotelegraph system, but being continually short of funds and receiving pay for his services in stock from which he could realize nothing he became desperate, and took poison in the laboratory in which he has been recently engaged, at 76 Beekman street. Mr. Radcliffe is a civil engineer, who undertook about ten years ago the planning of a general system of underground lines in which he hoped to combine all the electrical companies. The Western Union Telegraph company gave encouragement to the project at that time.

Complaints are made in Newark, N. J. that the telephone exchange, although nominally open all night, is practically useless at that time, although a young man and two boys are kept on duty who are supposed to keep each other awake, but without success. Similar complaints have been made regarding night service in other localities, the difficulty appearing to be that the business is insufficient to warrant proper attention.

The American Telephone and Telegraph company continue to profit by the record which they made during the blizzard. They now have more orders for Boston wires than they can accommodate, but are constructing another line over a new route. They are also reaching out toward Buffalo and will be ready for business through the state of New York before winter sets in. The system has grown in popularity among the manufacturers located in Connecticut, most of whom have offices and salesrooms in either New York or Boston. All the lines of this company are built in the most substantial manner in order to insure continuous service to subscribers.

It was reported a few months ago that arrangements were being made under the direction of the United States Lighthouse board for screening the electric lights on the river sides of the Brooklyn bridge. It now appears, however, that the bridge trustees are opposed to any change of this kind, although it is in the interest of safe navigation through the East River. On account of this conflict between the local and national government authorities the whole matter has been referred to the United States attorney general for such action as he may consider proper.

The first of the lot of ten new electric motor cars operated by the Julien storage battery made a very successful trial trip over the Fourth avenue line to-day. These cars have two trucks with two pairs of wheels on each. The motors are mounted on the trucks and there is very little grinding of the wheels in rounding the sharp curves on street corners. The car stood for some time near the post office awaiting its load of invited guests who were taken over the road to the Grand Central depot, and a collation was served at the Murray Hill hotel. The cars weigh from eight to nine tons, including the battery, of which there are 144 cells placed on twenty-four trays. In going through the tunnel under Park avenue the car was run at a speed of about ten miles per hour. The track on this line is better adapted for motor traction than the ordinary horse railroad, as the track was laid for the accommodation of the passenger and freight cars of the New Haven and Harlem railroads, which were formerly drawn by horses down to the old Twenty-seventh street and Center street stations. It is understood that Mr. Vanderbilt will approve the substitution of electricity for horses even at a greater cost, believing that its use will lead to increased traffic.

The death of Prof. Richard A. Proctor of this city, Sept. 12, from yellow fever contracted in Florida, was startling in its suddenness. No man has done more to popularize science, both in England and America, and he had hosts of admirers who never had the pleasure of meeting him personally. He was the founder and editor of *Knowledge* now published monthly in London, which has at times given considerable attention to electrical matters. P.

Michigan Electric Railways

DETROIT, Mich., September 15.—The common council has granted a franchise for an electric street railway, to an organization consisting of John F. Talbot, Frank E. Snow and others. The route which this road will pass, embraces some of the most important streets in the city, and will extend to the city limits, there connecting with the existing line of the East Detroit and Grosse Pointe company, making a road of some sixteen miles in length. Some slight opposition has been manifested on the part of certain citizens who stand in the way of needed improvements, to the granting of any more street railway franchises, but the better judgment of the council prevailed, and in awarding this franchise a satisfactory service is assured. During the past few years, the population of this city has shown a remarkable increase, and with it came a demand for more rapid and extended street railway facilities. This road will go far toward meeting the demand, and the personnel of the company is a guarantee of the road being a model of its kind. From 6 A. M. to 8 A. M. and 5 P. M. to 7 P. M. the fare will be 3 cents. Two other applications for franchises are before the council and will probably be taken up at an early date.

At Adrian, the city council has granted a franchise to the Adrian Electric Railway company to construct a belt line, running east and west from the college to the depots, to be immediately followed by the construction of a north and south branch to the industrial home.

The Detroit and Grosse Pointe electric road is now in full operation, and giving excellent satisfaction.

The road at Sault St. Marie is rapidly approaching completion.

As noted in these columns some time ago, Almeron Kraatz, a lineman in the employ of the Brush company was awarded $10,000 damages for injuries sustained whilst in the discharge of his duties. The case was appealed and August 26th Judge Brevoort of the Circuit court handed down his decision ordering a new trial, on the ground that he award was too much, and in accordance with the evidence in the case, unwarranted; that the money invested at the current rate of interest would bring Kraatz an income of almost double that which he has hitherto been able to earn.

The Fisher Electric Motor company filed articles of association August 25th. The capital stock is $200,000. The company proposes to buy, sell and deal in property for use in the construction, equipment and operation of electric street railways. The stockholders are: Hugh McMillan, 1,318 shares; Frank E. Fisher, 562; Wm. A. Jackson, 1,334; Frank E. Snow, 339; Geo. H. Lothrop, 120; E. B. Hutchinson, 200; F. A. Forbes, 24; Gilbert N. McMillan, 40.

Articles of incorporation of the Boston Copper company were filed with the county clerk, August 25th. The company starts with a capital of $250,000, of which amount $125,000 is paid in. Real and personal property valued at $25,000 is conveyed to the corporation contemporaneously with its incorporation. The company propose to engage in the smelting, refining and manufacturing ores, and particularly copper, by fire, humid, electrical and other mechanical processes. The stockholders are Horatio G. Parker, Charles L. Harding and Edgar Harding, of Cambridge, Mass., and Hoyt Post, of Detroit, each of whom holds twenty shares, and H. G. Parker, trustee, 4,900 shares. C.

Indianapolis Items.

INDIANAPOLIS, Sept. 15.—The Jenney Electric company of this city has received an order from Coshocton, O., for an electric outfit amounting in all to $12,000. This company also furnished the lighting plant for the New Union Railway Passenger station and train sheds. The station proper is a brick building, with heavy stone trimmings, three stories in height, and 150 feet square. The train sheds are 750 feet long by 150 feet wide. The lighting plant consists of five dynamos driven by two 150 horse power Buckeye engines. Three large boilers furnish the steam, using natural gas for fuel. Twelve hundred incandescent lamps are distributed about the station building and 70 arc lamps are used in the train sheds and for outside lighting about the approaches. A portion of the plant is already in place and in use.

The Western Union Telegraph company is fitting up a branch office in the main waiting room of the new union station, and is also putting in the union telegraph office, which will occupy a room about 25x40 feet. The outfit will consist of a 50-wire switch board with springjack attachment, three octette tables and other necessary furniture. The wires are carried into the office in cables from Meridian street, a distance of about 500 feet, the cables being strung just under the roof of the train shed.

Notwithstanding the city has just awarded a contract to the gas company for street lighting at a cost of about $10,000 above what an electric light company agreed to light the whole city for, placing lights at any and all points designated by the committee on light, an ordinance was introduced at the session of the council August 20th, asking for the erection of 200 vapor lights in an unlighted portion of the city, while calls for more light are coming from all directions. The *News* has criticised the action of the council in the matter of light rather severely, and on two or three occasions has published the names of the thirteen members who have stood by the gas company from the first. As an outcome, one of the members who voted for gas for street lighting introduced a resolution which, after setting forth that the *News* was trying to mislead the public in regard to letting the contract for light, censured the paper for its lack of truth, etc. The resolution was adopted by the same vote that adopted the gas light ordinance.

The MacNeal Electric Street Railway company's ordinance came up before the board of aldermen, and was met by protest from property holders and residents on the north side streets on which it was proposed to lay tracks. The company's attorney made an argument in its favor, and the electrician, W. J. Clark, explained its proposed system. He said they would not use the storage system as that had not proved a success so far. If allowed to go ahead they intended to put down their track and the conduit system, the same as used in Allegheny City, in first class order. The committee made numerous recommendations. Among them the rejection of the entire ordinance until the Supreme court shall have decided as to the city's rights in the matter of chartering additional street railroad companies. An amendment to the ordinance, as it came from the council, cutting off all streets on the north side, was adopted. This virtually kills the whole matter for the present at least.

A committee of the common council of Allegheny City, Pa., have been in this city this week inspecting the Jenney Electric company's light in this city with a view to its adoption in their city. They went from here to Madison, Ind., where the Jenney light is in use for street lighting.

The natural gas companies have agreed to furnish gas for the arches and display lights, as proposed by the citizen's committee at rate of 25 cents a night.

President Caven of the Brush Electric Light company says that the machinery is on the way, and the company will probably be ready to furnish light inside of the limit named in the contract with the city. The light will be used on Washington street from one end to the other, and several other streets in the business part of the city.

At each session of the city council new ordinances are introduced calling for light in different parts of the city in addition to that named in the contract entered into some time ago. In many cases the people ask for electric light.

A new industry is about to be established here. For some days past Wm. M. Bleyer of St. Louis, and C. E. Bleyer of Chicago, have been in the city in the interest of the Smith feed water heater and purifier, described as a device for preventing the formation of scale in boilers, saving of fuel and protecting the boiler. A company has been formed here under the name of the Indiana Feed Water Heater & Purifier company, with a capital of $100,000; and articles of association have been filed with the secretary of state.

One of the city papers devotes a column to fire department notes, in which during last week the following appeared: "There is probably not another city in the country where the damages arising from poorly insulated electrical wires are permitted to go unnoticed as in this. At almost every arc light the insulation is imperfect, and, while no person has been injured, it is a matter that demands attention. Several fires have occurred in this way, but have been kept from the papers."

The Indianapolis Base Ball association has been trying for some time past to light its park with natural gas and introduce evening games, but so far has not succeeded. The club found that hard hit grounders could not be seen. They intend to put in more lights, and try it again. This has been tried with electric lights, but never successfully accomplished, and it is a question whether it can be done by gaslight, though some of the players are of the opinion it can.

M.

From Omaha, Neb.

OMAHA, Neb., Sept. 15.—The Nebraska Telephone company has a large force of men at Norfolk, Neb., pushing the work of installing an exchange of seventy-five subscribers. Branch lines will be built, bringing in several towns.

The new Edison electric light plant at Norfolk will be completed this week. Their new waterworks system is just finished, and a grand celebration of the business men, with invited guests from all parts of the state, has been arranged for the near future.

A telephone exchange is being built at Fairbury, Neb.

About a year ago the town council of Hastings, Neb., declared that all telegraph and telephone companies should erect no poles less than forty feet in length inside the city limits, and imposed other conditions which would necessitate the rebuilding of the entire telephone exchange. Their present capacity is ample for some time to come, and as yet the companies have made no attempt to replace the twenty-five feet poles now in use for those of sufficient height to please the tastes of the council. The street commissioner was recently instructed to remove all old poles not up to standard height, unless the different companies took steps at once to reconstruct their lines. There are over 200 subscribers to the telephone exchange, a successful electric light plant, and two telegraph companies. No action by either side has yet been taken.

The Clay County Telephone company, organized to use Cushman's instruments, have been taken into camp, on their own request, by the American Bell Telephone company, and are now licensed by consent of the Nebraska Telephone company.

Lincoln, Nebraska, has a paving boom this year, and as usual, the telegraph and telephone poles are not on the curb line in many places; as a result many of them will have to be moved. The council ordered all this done in sixty days, but have since modified the order in that poles only need to be moved as fast as paving is done.

The new Edison plant in the Omaha and Grant Smelting and Refining company's buildings and yards, was successfully started two weeks ago, and is giving excellent satisfaction.

The Grand Opera house in this city will make a change from gas to Thomson-Houston arc lights.

The Western Engineering company of Lincoln, Neb., has closed contract for a 200 light plant in the St. Joseph, Mo., court house; also a 300 light plant in the Iowa Institute for the Deaf and Dumb at Council Bluffs, Ia.

The light and power plant at Kearney, Neb., now in course of construction, will be finished in ten days. One 20 horse power and one 30 horse power motor will be put in. The lighting plant will start with 400 lamps, while the capacity will be 1,000.

The United States company of this city will furnish the plant for the "Siege of Sebastopol" to be given nineteen nights in September, during the Omaha and Lincoln fairs.

The Council Bluffs and Omaha Bridge company are pushing forward the work on the bridge and motor line which is to connect Omaha and Council Bluffs with nine miles of track. The power house is under way and the material for the road is arriving daily. Twenty cars will be put on at first, and the number will be increased as wanted. The Thomson-Houston company have the contract for the building and entire equipment of the road. Mr. Turner, now of the Thomson-Houston company, but formerly in the employ of the Van Depoele Manufacturing company, who is to take charge of the construction of the motor plant, has arrived in the city.

Israel Lovett, for the past five years superintendent of the Midland Electric company, has resigned to accept the position of assistant superintendent of the Council Bluffs and Omaha Bridge and Railway company.

The Midland Electric company is wiring the Lindell hotel at Lincoln, Neb, for a sixty number annunciator with fire alarm and guest call system.

W.

THE ELECTRIC LIGHT.

The Jackson and Wells street bridges in Chicago have been comple ed, and are lighted by electric light.

The Thomson-Houston company of Chicago has sold an incandescent plant to George Tileston of St. Cloud, Minn.

The Sioux City Electric Light company has ordered a thirty-four arc plant of the Thomson Houston company of Chicago.

Joseph Benson, Centralia, Ill., has recently increased his electric light plant by purchasing a number of 2,000 candle-power Brush arc lamps.

T. H. Smith, Jamestown, N. Y., has recently increased his electric light plant by purchasing 12 arc lamps from the Brush Electric company.

The American Mining & Smelting company of Leadville, Col., has ordered a 25 arc light plant of the Western Electric company of Chicago.

The Thomson-Houston company of Chicago has sold an incandescent light plant to the Saginaw Manufacturing company, of Saginaw, Mich.

The Rust-Owen Lumber company of Drummond, Wis., has purchased an incandescent outfit of the Thomson-Houston company of Chicago.

The Mahoning Electric Light company of Youngstown, O., has ordered a thirty-five arc plant of the Thomson-Houston company of Chicago.

The Wichita, Kan., Electric Light company have sent an order for a 2,500-light incandescent plant to the Thomson-Houston company of Chicago.

The Chicago Electric Light Enlarging company has been organized; capital stock, $5,000; incorporators, Adolph Graeff, Alfred Graeff and E. Graeff.

A plant of 50 arc lights has been ordered by the Nevada Electric Light & Gas company of Nevada, Mo., of the Thomson-Houston company of Chicago.

The Greeley Electric Light company of Greeley, Col., has sent an order for an 800 light incandescent plant to the Thomson-Houston company of Chicago.

Armour & Co. have increased their plant at the stock yards, Chicago, by the purchase of seventy-five arc lights of the Thomson-Houston company, Chicago.

The Leavenworth Waterworks company, Ft. Leavenworth, Kan., has recently increased its incandescent electric light plant by purchasing a new Brush dynamo.

The Merchants' Arc Light & Power company of Chicago has been incorporated; capital stock, $30,000; incorporators, William H. Collins, Joel W. Stevens, and Benjamin Keigher.

The Thomson Houston company of Chicago has sold a fifty light arc plant and a 500 light incandescent plant to the Cleveland Electric Light company, as an increase to the present plant.

The Brush Electric Light & Power company of Niagara Falls, N. Y., has again increased its electric light plant by purchasing a number of 2,000 candle power arc lamps of the Brush system.

The Reading, Pa., Electric Light & Power company will enlarge its plant, having ordered two 150 horse power engines and two Edison dynamos of a capacity of 800 ten candle power lights.

The Burlington Gas Light company, Burlington, Vt., has recently made an addition to its Brush electric light plant of one 30 light 2,000 candle power arc dynamo with a full complement of lamps.

The English Admiralty are beginning to recognize the advantages of accumulators for ship lighting, a fact which has long been evident to many other powers. Batteries are to be fitted to both the royal yachts.

The Clinton Electric Light, Heat & Power company of Clinton, Ill., has been incorporated; capital stock, $25,000; incorporators, Vespasian Warner, Clifton H. Moore, John Warner, Abner R. Phares and Richard Butler.

The depot and surroundings at Los Angeles, Cal., are to be lighted by a combined arc and incandescent plant manufactured by the Waterhouse Electric and Manufacturing company of Hartford, Conn. It will consist of eight double arc lamps, twenty-four 25 candle power and ten 100 candle power incandescent lamps. A fine exhibition was made of this plant before shipment from the factory, the incandescent lights burning perfectly steadily upon the arc circuit.

The city council of Tiffin, Ohio, has invited correspondence from electric light manufacturers relative to introducing street lighting by arc lamps in place of gas. The contract with the gas company expires within a few weeks.

The new reading room of the Chicago Public library has been opened. At night the room is illuminated by 120 incandescent lights of sixteen candle power each, arranged on three sides of the room and upon nine brass candelabra of eight lights each.

The Bank of Commerce, St. Louis, is to be lighted by electric light. A plant of 600, 20 candle power lamps will be installed. The two Edison dynamos will be driven by an Armington & Sims engine. The plant will be installed by the Porter Engineering company.

The Marysville Electric Light company, Marysville, Kan., recently purchased a large arc and incandescent Brush electric light plant. The installation of the plant is about completed. All the lights originally ordered have been placed and the company has ordered additional arc lights.

The Brush Electric company of Cleveland, O., has recently sold a large electric light plant, consisting of 1,000 incandescent lights, to the Minneapolis, Minn., exposition. The same company has also rented the exposition 180 arc lamps. This exposition is one of the most successful in the country.

The Fostoria Electric Light company, Fostoria, Ohio, has recently increased its electric light plant by purchasing a number of arc lamps from the Brush Electric company, Cleveland, Ohio. This company is now operating in the neighborhood of 100 Brush arc lights, and a number of Brush incandescent lights.

John Wanamaker, Philadelphia, Pa., has just purchased of the Brush Electric company, Cleveland, Ohio, thirty 2,000 candle power double arc lamps, for the purpose of increasing his electric light plant, which now consists of 300 Brush arc lamps and 200 or 300 Brush incandescent lamps. This plant is now much larger than many of the central stations throughout the country, and has been in operation for a number of years.

The nineteenth annual meeting of the Fire Underwriters' association of the northwest was held in Chicago Sept. 12 and 13. In his paper on "Rates and Rating," Charles E. Bliven, manager of the American Fire Insurance company, Philadelphia, spoke briefly of the phenomenal growth of the electric light system. It formed, he said, a new risk about which insurance men as a rule knew little. He commended the subject to their earnest consideration.

E. W Tisdall, general agent of the Brush Electric company of Philadelphia and vicinity, has recently sold to Geo. V. Cresson, Philadelphia, Pa., an incandescent and an arc light plant. The incandescent plant consists of a 200-light Brush dynamo, with full complement of lamps in position. The arc light plant consists of one Brush 45-light arc dynamo, with forty lamps in position. The construction work is being done by the wiring contractor, L. Porsh, who does a large share of E. W. Tisdall's work.

George A. Mayo has been engaged by the Van Depoele company of Chicago as electrician. Mr. Mayo is developing the new incandescent system, which the company will soon put on the market. The tests which have thus far been made indicate that the lamps will have a remarkably long life. Mr. Van Depoele continues to act as consulting electrician of the company as his contract with the Thomson-Houston company enables him to devote considerable time to the work of the corporation which bears his name.

The London *Electrician* tells the story of a Pittsville workman who fell from the roof of a house and was saved from being dashed to pieces by a pair of electric lighting wires. It is said that the two leads were carrying a current of 1,000 volts, alternating current, which effectually prevented him from letting go until some one came with a long ladder and helped him down. Thus it would appear that the full force of a powerful current, so far from killing him, actually saved the man's life; but he is probably the first person who has received such a current, and been thankful for it.

A cable dispatch from Cuba announces that a Havana paper has accused the Havana Electric Light company of attempting to bribe the aldermen in order to secure the contract for lighting the city. A New York representative of the company said: "All there is about it is this: The Consolidated Gas company were getting scared at the progress we were making, and employed this infamous device to defeat us. The people of Havana want electricity, and I do not think the circulation of any such absurd stories will carry any weight. The gas company has been reaping a rich dividend from the enterprise, and naturally will make every effort to retain the patronage. If we cannot get the charter by fair means I assure you we will not resort to trickery or bribery."

"'It is an ill will that blows nobody good,' says the old saw, and our American contemporaries must be pleased with the various legal opinions on the battles fought in law courts over incandescent lamp patents, for the competing companies are largely advertising, each of course claiming decisions in its favor and as pulverizing its opponent," says the London *Electrical Engineer*. "We are practically certain that the money spent over these lawsuits will never be repaid to the companies during the life of the patents. A good business maxim, and one to be commended, is that which says, 'Keep on experimenting, take out a patent for an improvement that can be shown to be an improvement about every fourth year, let all your clients, and all who may be clients, know of the improvement, while ostensibly dropping the previous manufacture.' One word—don't make too much of your improvement before the old stock is run low, and the new stock ready, or buyers will reject the old in favor of the new."

THE ELECTRIC MOTOR.

The electric motor which the City Railroad company of Brooklyn, has introduced on several lines was tested at a trial trip recently, and was pronounced satisfactory.

The West Chicago Rapid Transit company, which proposes to employ steam power or electricity, asked for a franchise at the city council meeting Sept. 10. The petition was referred.

The Manchester and Richmond Street Railway company has contracted with the Sprague company for the equipment of its ten cars with the Sprague system. This will make three roads and one hundred cars, which the Sprague company has in operation or under contract in that city alone.

The Thomson-Houston Electric company has closed a contract with the West End Street Railway company of Boston, for the equipment of twenty cars with electric motors. Each car will be lighted with incandesent lamps. Two motors will be provided for each car. Lightning arresters will be fitted on all the cars.

Work is progressing rapidly on the electric road connecting Council Bluffs and Omaha, which is being constructed by the Thomson-Houston company It is hoped that the road will be in operation in less that a month. The Des Moines road, which is being equipped by the same company, will probably be in operation in four weeks.

The Van Depoele company has shipped to the Rockford Electric Power company, of Rockford, Ill , another ten-horse power motor The plant will soon be running to the full capacity of 100-horse power Motors are now used in printing offices, flour mills, laundries, spice mills, furniture factories, tailor shops, and in a picture gallery for air brushes and for elevator work.

The Kearney Brick company of Kearney, Mo., put into operation their first electric motor on Sept. 3d, a 30 horse power, for the purpose of testing it, preparatory to using it on Monday. It worked most admirably, making a very regular and even motion, revolving 910 times per minute. This company has a second electric motor of 20 horse power, which will be put into position at once.

The new power station for the Sprague electrical road in Davenport, Ia., will contain a 160-horse power Hamilton-Corliss engine. The electrical equipment will consist of two 25,000 Watt dynamos and two 30,000 Watt dynamos. The building is so arranged that the electrical equipment of the company can be doubled, as it is the intention of the directors to supply power as well as to generate current for their own cars.

The electric road at Dayton, which was equipped by the Van Depoele company of Chicago, is meeting with marked success. The cars, 12 in number, run smoothly and rapidly, and not the slightest difficulty is experienced in the operation of the system. The road is six miles in length. The plant consists of two Lane & Bodley engines of 150-horse power each and three Van Depoele generators of a capacity of 100-horse power each.

It will be remembered that the electric plant of the Capital City Railway company of Montgomery, Ala., was burned a short time ago. A Montgomery paper says the company "have determined in the meantime to put mules in as a temporary expedient. They prefer the light Mexican mules to the large mules of Kentucky and Tennessee, because the large mules get 'stove up' in the down grade work and do not possess either the activity or speed of the Mexican."

The ten new cars fitted with electric motors, which the Fourth Avenue company, Providence and the board of aldermen permitting, proposes to put in service between the Grand Central station and the city hall, are nearly finished, says the New York *Sun*, and one of them is already on the tracks and making experimental trips. Between midnight and dawn is the hour selected for the trials. It is a regular palace car, and will leave the Broadway "Pullmans" far behind when it begins regular trips. It is roomier and more expensively fitted up than the best of the cars in the pre ent service, and is brilliantly lighted by electricity.

THE TELEPHONE.

The experiment of keeping the telephone exchanges open in London on Sunday, a plan which went into effect a few weeks ago, has proved so popular that the plan will be continued permanently.

The government telephone case has been set for hearing at Washington on October 9th, says a Washington dispatch. Mr. Thurman, who has been acting as chief counsel for the government in the case, expects to make the opening argument.

The fact that it costs more to use a long distance telephone wire than to use a telegraph wire is frequently commented upon, but the cost does not prevent the service from being popular. Here is the way in which it is figured out that the telephone message is cheaper. For example: A five-minutes' conversation between New York and Boston costs $2, considerably more than a simple dispatch, but the telephone communication will, of course, afford more explicit expression, and it will relatively be cheaper, considering the number of words. The average speaker will readily "rattle off" 150 words per minute, thus making the actual toll for 750 words between New York and Boston only $2, about one-sixth of what an equally voluminous telegraph message would cost.

A young man claiming to represent a firm of lawyers of some prominence recently circulated a petition in South Water street, Chicago, asking the common council to reduce telephone rates to $75 per annum. He asked each petitioner to sign an agreement to pay $5 or $10, as the case might be, should the object of the petition be obtained. Signers to the agreement and to the petition were numerous. It is claimed that some of the aldermen are behind this scheme and expect to share in the profits of the firm whose agent is circulating the petition. It is known that some of the leading members of the council are determined to make one more effort to reduce the telephone rates as soon as the council reconvenes. The fact that so many signers were obtained indicates that if the council attacks the telephone company it will have a large support.

A dispatch of Sept. 10 from Columbus, Ga., says: To-night the telephone wires and the electric wires became entangled while the full current was on the electric light wires. The telephone wires were melted, and night operator W. H. Galloway had a narrow escape as the current communicated with the central office. He had the head telephone on at the time, but prompt action on his part saved his life.

THE TELEGRAPH.

A dead telegraph pole fell in New York city last week, and barely missed striking several children who were playing near it.

The Western Union directors Sept. 12 declared a quarterly dividend of 1¼ per cent. The statement presented shows net earnings, partly estimated, for the quarter ending Sept. 30 of $1,550,000. Interest and sinking fund charges amount to $24,082, leaving $1,345,198 surplus for the stock. The dividend is payable Oct. 15 and the books closed Sept. 20, both for the dividend and election purposes.

A cable dispatch from Paris says: Operators and clerks of telegraph offices to the number of 600 held a meeting yesterday and resolved to open a subscription which would enable them to put themselves in communication with the telegraphers in all parts of France for the purpose of securing united action for the redress of their grievances. A committee was appointed to draw up and lay before the minister of posts and telegraphs a petition complaining of the unjust system of promotion in the service, long hours of work, insufficient pay, extra labor imposed without remuneration, and other causes of discontent, which they respectfully ask the government to take into consideration.

Business Mention.

The Empire City Electric company of 15 Dey street, New York, are out with "Circular C"—a folder showing a great variety of push buttons, bell pulls and electric bells.

The Gordon Steam Pump company of Hamilton, O., shows in its May, 1888, catalogue many new styles of pumps for every purpose imaginable. Constructors of electric light plants should consult this catalogue before making contracts for pumps.

The Western Electric company has recently taken an order for seven miles of electric light cable for the Chicago Arc Light & Power company, and an order for two miles of cable of the same description for the East River Electric Light company of New York.

"The demand for our new combination alarm box and trap lock for factories, mills and public buildings described in the columns of the WESTERN ELECTRICIAN recently, far exceeds our expectations," writes the United States Electric Fire Alarm company of Evart, Mich.

J. R. Burdick, formerly with the Dorsett company, is now the general western sales agent of the Callender Insulating & Waterproofing company, with quarters at 68 Commerce building, Chicago. A recent single sale amounting to $20,000 is an excellent proof of the appreciation in which the Callender wires are held by consumers.

Marshall Field & Co. of Chicago, have ordered of the Western Electric company a speaking tube telephone system of thirty stations for their retail dry goods store. They have had a similar system in use in their wholesale house for some time, and are much gratified at its operation. This system was described in No. 1, Vol. I. of the WESTERN ELECTRICIAN.

Hazazer & Stanley, 32 and 34 Frankfort street, New York, have recently issued a catalogue devoted to annunciators, electric bells, electric gas lighting apparatus, burglar alarms, speaking tubes, electric door openers, push buttons, letter boxes and electric goods in general. Many novelties are shown, and intending purchasers should send for a copy of the catalogue before making a choice.

William Oswald, agent for the Sprague Electric Railway & Motor company in Louisiana and Mississippi, has installed at the printing office of Hunter & Genslinger at New Orleans, a three horse power Sprague electric motor to run one half-medium nonpariel press, one Whitlock drum cylinder press, three quarto nonpariel presses. This is the sixty-fifth Sprague motor running in the city of New Orleans, and all are giving perfect satisfaction.

Professor A. E. Dolbear recently made some tests of the Samson battery made by the Electric Gas Lighting company of 35 Arch street, Boston, which developed remarkable results. A number 1 Samson cell showed an e. m. f. of 1.44 volts; internal resistance, .14 ohm; current at outset, 1.16 amperes; current after 30 minutes, .52 ampere. A number 2 Samson cell showed an e m f of 1.47 volts; internal resistance, 11 ohm; current at outset, 1.11 amperes; current after 30 minutes .70 ampere.

The Sprague Electric Motor company has motors in use in 128 different industries. In mining their motors are used for air compressors, hoists, pumps, and hauling on tramways. In one of the California mines, some of the motors are fourteen miles away from the generating dynamos. The making of motors for stationary work by the Sprague company has been less talked about than the same company's achievements in making motors for railways, but it is a very prosperous and growing business.

The Matchless Metal Polish company, of 88 Market street, Chicago, is having large orders for its Tripoline and Matchless metal polish. They have both been submitted to severe tests and their superiority has been demonstrated by a large number of engineers in all parts of the country and they are unanimous in praising it. It has been used on United States ships whose engineers have recommended its general adoption. Army officers have commended it as the most serviceable polish for cleaning guns.

Electrical Patents.

Issued August 28 and September 4, 1888.

388,430. Galvanic Battery. Abraham V. Meserole, New York, N. Y.

The first claim is given: "1. The combination, with the two electrodes, of two electrolytes for said electrodes, composed, respectively, of sulphate of mercury in dilute sulphuric acid and nitrate of mercury in dilute nitric acid,"

388,438. Circuit Changing Device for Burglar Alarms. Frank H. Nutter, Malden, Mass.

388,442. Underground Electric Conduit. Edward H. Phipps, New Haven, Conn.

388,453. Loop Key. Charles E. Scribner, Chicago, Ill.

The device is a "listening in and calling key" and is designed for use upon telephone exchange switch boards. Several may be mounted upon the same strip or frame so as to be brought into the smallest possible space.

388,454. Electric Resistance Measuring Apparatus. Charles E. Scribner, Chicago, Ill.

The invention is designed especially for multiple switch board systems. The more important of the two claims follows. "1 A resistance measuring apparatus consisting, essentially, in a circuit including two batteries of substantially equal electromotive force and a rheostat, a shunt wire, including a current indicating apparatus connected between said batteries at one end and at a point of the circuit beyond the rheostat at the other end, and a connecting device for closing said circuit with the circuit to be tested."

388,477. Electrical Conductor. William A. Conner. Pittsburgh, Pa.

The claim follows: "An electric cable having a central conductor or core and a number of insulated conductors arranged spirally around the central conductor, and each having a cross section greater in breadth than thickness, and composed of a number of wires."

388,481. Telegraphy. Patrick B. Delaney, New York, N. Y.

The primary object of the apparatus to send neutralizing or counter currents into the line after each interruption of the circuit. The last claim is as follows: "6. The combination at a receiving station of a receiving relay actuated by impulses received from the distant transmitting station, a contact maker moving in response to said impulses, contact maker actuating devices controlled by the relay, a line connected to the contact maker, alternate contacts traversed by the contact maker, and sources of electric energy of opposite polarity with which said alternate contacts are respectively connected, whereby impulses are sent into the line connected to the contact maker as it passes over each electrically connected contact."

388,482. Dental Electric Apparatus. Charles A. Eisenhart, York, Pa.

The invention is designed for relieving the suffering occasioned by the extraction of teeth and for facilitating an examination of the mouth.

388,487. Suspending Overhead Electric Wires. Alfred E. Harris, London, England.

The claim follows: "The combination, with a series of telegraph or telephone poles for suspending or connecting the line wire, of a pair of movable bars normally held to place by springs and applied to the opposite sides of the pole near its top, and adapted to recede from each other and relieve the strain on the wire under stress of weather."

388,505. Thermal Circuit Closer for Fire Alarms. Henri S. Petit and Henri S. Bresson, Vitoria, Spain.

Claim 3 is given: "The combination, with a metallic frame, of a metallic wire stretched thereon, a stationary contact, a movable contact opposed to said stationary contact, and a spring adapted to press said movable contact onto said stationary contact upon a sudden rise of temperature, said wire holding said contacts apart by its tension."

388,512. Electric Motor. Jean T. van Gestel, New York, N. Y.

388,513. Commutator for Dynamo Electric Machines. Jean T. van Gestel, New York, N. Y.

388,514. Electric Tram Car. Jean T. van Gestel, New York, N. Y.

388,538. Traveler or Trolley. Leo Daft, Plainfield, N. J.

The trolley is designed to receive the electrical impulse from a conductor or conductors, generally an overhead conductor, and to transmit said impulse to a motor upon the track.

388,581. Electric Belt. Harry P. Pratt, Chicago, Ill.

388,583. Electric Meter. Karl Raab, Kaiserslautern, Bavaria, Germany.

388,592. Ice or Refrigerating Machine. John E. Siebel, Chicago, Ill.

The first claim is as follows: "1. The combination of the metal condenser coil of an ice or refrigerating machine and positive and negative electrodes connected by a suitable conductor, whereby water containing, inherently, a substance having a corroding effect on metal, passed into contact with the electrodes, is prevented from corroding the coil."

388,594. Electric Arc Lamp. Lewis W. Spencer, Hoosick Falls, and Frederick P. Jaquith, Hoosick, N Y.

388,601. Electrode for Secondary Batteries. Sylvanus L. Trippe, St. Louis, Mo.

The invention consists in an electrode for a secondary or other battery composed of an exterior perforated plate or envelope, having attached to it internally a suitable conducting wire, and an interior perforated and corrugated plate, there being a suitable composition between the plates, and the plates being held or pressed together.

388,622. Electric Motor for Self-Winding Clocks. Frank W. Brainerd, Chicago, Ill.

The invention consists in dispensing with the usual dog or locking pawl applied to the clock movement and applying to the motor itself, a device which arrests the armature drum in any of one or more predetermined positions when its current has ceased. The last claim is given: "7. In a clock mechanism having a winding electric motor with a rotating armature, the combination, with the armature drum, of a pivoting arresting detent intercepting the path of the armature drum upon the backward movement of the same, and a frictional connection between the armature shaft and said detent for throwing the same into the path of the armature drum during the retrograde movement of the latter."

388,628. Process of Making Battery Zincs. Robert L. Carr and Parker Borden, Fall River, Mass.

The first claim follows: "1. The improved process of constructing battery zincs herein described, the same consisting, essentially, of forming a body consisting wholly or in part of an amalgam of zinc and mercury, and a cap consisting of pure or approximately pure zinc, and having a conducting wire cast therein and projecting at two sides thereof, placing said body, cap, and wire in a closed vessel, and submitting them to heat to unite them."

388,631. Electric Fire Alarm Signal. S. A. Chase, Evart, Mich.

388,645. Apparatus for Hardening and Tempering by Electricity. Philip Diehl, Elizabeth, N. J.

The sixth claim follows: "6. The combination, in a device or apparatus for hardening or tempering needles or similar articles, of a chute or conveyer through which the articles are to be passed, a source of electricity having one pole connected with the chute at a given point, and an adjustable contact device connected with the other pole of the source, through which connection may be made at different points along the length of the chute."

388,668. Storage Battery Plate. Charles D. P. Gibson, New York, N. Y.

The first claim follows: "1. A storage battery plate consisting of a sheet of metal having transverse openings, a button of the same material extending through each opening and having an enlarged head at each end, and active material filling the spaces in the openings about the buttons."

388,690. Electric Railway Station Indicator. George H. Kirwan, Wilkesbarre, Pa.

388,697. Arc Lamp. John Lea, London, England.

388,708. Electric Meter. Henry G. Morris, Philadelphia, Pa.

388,723. Electric Arc Light Support. Benjamin Schardt and George Jones, Dayton, Ohio.

388,746. Electrode for Storage Batteries. Jean T. van Gestel, New York, N. Y.

The first claim reads: "1. In an element for storage batteries, the combination of the base plate of metal having low electrical resistance and the covering of lead or lead alloy integral throughout, united at openings through the base plate from opposite sides thereof, and provided with the series of receptacles at opposite sides containing active material."

388,753. Electric Motor. John Batley, Philadelphia, Pa.

The object of the invention is to employ the direct attraction of the armatures of a series of electro magnets to vibrate a series of levers, which in turn cause a rotary movement of the motor shaft. Of the eighteen claims, eleventh and sixteenth are given: "11. The combination of a motor shaft, a notched friction wheel secured thereto and electro magnets, a pivoted armature therefor, and a pivoted friction lever actuated thereby, and having its operating face curved to work in contact with the raised portions of the friction wheel.

"16. In an electro motor, the combination of a series of stationary actuating electro magnets, a series of pivoted vibrating armatures, a separate source of electrical energy to each of said magnets, and switches to cut out one or more of said electro magnets from its source of energy."

388,757. Furnace for Baking Electric Light Carbons. John Burns, Rochester, N. Y.

388,791. Switch Board for Telephone Exchanges. Charles E. Scribner, Chicago, Ill.

The switch board is of the multiple type. The principal feature of the invention consists of providing branch or half connections for each of the lines, the said branch or half connections extending to terminals placed within reach of the switchmen at the different boards so that each switchman, in addition to the usual switches for lines assigned to his board, may have within easy reach a bolt or terminal of each one of all the other lines of the exchange. The last claim is given: "9. The combination, with telephone lines from the different subscribers' stations, terminating in spring jacks and annunciators at their respective boards, of branches from all of the lines terminating in studs upon the other switch boards, trunk lines connecting the different switch boards together, connecting cords and plugs with which the lines of the different boards may be connected through the medium of the trunk lines, switching devices in connection with the operator's telephone and calling generator to connect with the studs or terminals of the said branch connection, whereby an operator at one board may signal an operator at another board over the line wanted, to complete the connection."

388,803. Railway Telegraphy. Granville T. Woods, Cincinnati, Ohio.

388,836. Electric Bell. Moses G. Crane, Newton, Mass.

388,837. Electric Annunciator. Charles H. Crockett and Chancellor C. Allen, Boston, Mass.

388,859. Electrical Cash and Parcel Carrier. George F. Green, Kalamazoo, Mich.

388,862. Submarine Torpedo Boat. Horace P. Griswold, Providence, R. I.

Claim 13 gives an idea of the invention: "In a submarine torpedo boat, the combination, with a float attached to the boat by a flexible connection and a catch for retaining said float in position, of mechanism, for automatically releasing the float."

388,869. Electric Signal. Henry T. Hill, Manchester, N. H.

388,876. Magnetic Annunciator. William Humans, Cambridge, Mass.

388,877. Magneto Electric Machine. William Humans, Cambridge, Mass.

388,922 Telegraph Exchange System. Robert J. Sheehy, New York, N. Y.

The first and sixth claims are given: "1. In a telegraph exchange system, the combination of a central controlling device consisting of a source of alternating, intermittent, or pulsatory electric impulses connected through all the several instruments of the system, and conductors leading from the recording devices of each instrument of the system to the central station.

"6. The combination of a source of alternating, intermittent, or pulsatory electric currents located at a central station, recording instruments located at different points operated or controlled by such currents, individual conductors leading from the central station to the several instruments, and a circuit-controlling device at each instrument for making and breaking the connections of the corresponding individual conductor, thereby operating the recording device of the instrument connected with the corresponding line."

388,955. Electrical Railway Conductor. Leo Daft, Plainfield, N. J.

The first claim follows: "The combination of parallel stringers, insulators suspended below each stringer, and a conducting rail supported intermediately below said stringers by connections to said insulators."

388,960. Manufacture of Secondary Battery Plates. Julian O. Ellinger, New York, N. Y.

The fourth claim is given: "The method of making a perforated secondary battery plate, consisting in forming two half-plates by first cutting apertures in metal sheets and then pressing such apertures into the desired form and securing said half-plates together."

389,001. Switch Mechanism for Electric Batteries. Charles E. Ongley, New York, N. Y.

389,011. Dynamo-Electric Machine. Andrew L. Riker, New York, N. Y. The 11th claim is given:

"11. In combination with an armature, Z field-magnets provided with the claw-shaped pole-pieces."

389,029. Regulator for Dynamo Electric Machines. Addison G. Waterhouse. The fourth claim is given:

"4. In a dynamo electric machine and in combination with an auxiliary collecting brush, a shunt conductor connecting said brush to the main circuit, a device located in the main circuit and responding to changes therein, and a circuit breaking device located in the shunt circuit and controlled by said responding device."

389,030. Regulation of Dynamo Electric Machines. Addison G. Waterhouse, Hartford, Conn.

389,062. Telegraphy. Patrick B. Delany, New York, N. Y. The first claim follows:

"1. The combination of a continuous line, relays in said line, a battery, Morse keys in the line circuit, by which the circuit is made and broken for the transmission of impulses of continuous current, corresponding to dots and dashes or the signals to be transmitted, a ground connection, and line grounding devices actuated by a magnet in the local of the relay at each end of the line, said grounding devices consisting of earth and line contacts which are momentarily brought against each other upon the movement of the relay each time that the circuit is broken.

389,080. Electro Magnetic Bell. William Humans, Cambridge, Mass.

389,096. Automatic Thermo-Electric Cut-off for Water Service Supply Pipes. Edwin A. Newman, Washington, D. C.

The first and last claims are given: "1. The combination of the water supply pipe system, its inlet valve and air valve connected to the upper part of the pipe system, the thermostat, the cut-off circuit controlled by the thermostat, and electro-magnetic devices for controlling the water inlet and air valves.

"7. The combination, with a section of pipe, of an electrically controlled drain cock or faucet placed between said section of pipe and the main, one or more thermostats placed in proximity to the section of pipe, as described, and adjusted to be called into action on a determinate change of temperature, and an automatic valve for admitting air to the pipe when the drain cock or faucet is opened."

389,098. Anti-Freezing Device for Water Pipes. Edwin A. Newman, Washington, D. C.

The sixth claims follows: "The combination of the main, the service pipe, the valve for opening and closing communication between the main and the service pipe, the electro-magnet, the valve spindle passing through the core of the magnet, the armature of the electro-magnet secured to the valve spindle, the sewer trap, the valve in the bend of the trap, the electro-magnet for operating the valve, the electric circuit, including the coils of the electro-magnets, the thermostat for automatically making and breaking the circuit, the faucet, and the circuit making and breaking devices operated by the faucet."

389,099. Anti-Freezing Device for Water-Pipes. Edwin A. Newman, Washington, D. C.

389,124. Apparatus for Utilizing Solar Radiant Energy. Edward Weston, Newark, N. J.

The first and second claims follow: "1. The combination of a thermopile, a means (such as mirror or lens) arranged to concentrate or converge solar rays thereupon, and a secondary or storage cell in circuit with said thermopile

"2. The combination of a thermopile, a means (such as a mirror or lens) arranged to concentrate or converge solar rays thereupon, and in circuit with said thermopile, a secondary or storage cell, and an electro motor."

389,125. Art of Utilizing Solar Radiant Energy. Edward Weston, Newark, N. J. The first claim is given:"

"Claim 1. The improvement in the art of utilizing solar radiant energy, which consists in converting said solar energy into electrical energy, and then storing and accumulating said electrical energy."

389,140. Galvanic Battery. Asahel K. Eaton, Brooklyn, N. Y.

389,142. Printing Telegraph. Bradley A. Fiske, U. S. Navy. The first claim is given:

"1. In a printing telegraph, the combination of a shaft, a type wheel mounted loosely upon said shaft, independent motors respectively tending to rotate the type wheel and shaft continuously in the same direction, an escapement for controlling the step-by-step rotation of the shaft, and a second escapement for the type-wheel, the releasing mechanism of which is affixed to and rotated by, said shaft."

389,151. Electrical Gas Lighter and Extinguisher. George L. Hogan, Olmstead, Ky.

389,184. Commutator for Electric Generators. Otto Zech, Detroit, Mich.

389,186. Secondary Battery. Charles B. Askew and James K. Pumpelly, Chicago, Ill. The first claim is given:

"1. The combination, with a plate of a secondary battery carrying the active material, of a supporting plate of porous material, one side of which conforms to the shape of the metal plate, and the other side of which is provided with separating ribs."

389,187. Voltaic Armor. John W. Baldwin, Boston, Mass.

389,189 Current Collector for Electric Railways. Josiah L. Blackwell, New York, N. Y.

389,196. Electro Magnetic Device. Henry A. Chase, Stoneham, Mass.

The object of the invention is to provide so strong a magnetic field that the core of the solenoid or armature of the electro magnet may be moved through a great distance. The first claim is given:

"1. An electro-magnetic device comprising a spool having a tubular shank and soft iron end piece substantially closing the open end of the shank, and successive coils of wire wound thereon, a hollow core or armature having a closed end located within the said spool, a retractile spring for the core and contained within it, and a rod for supporting the said spring."

389,197. Electric Motor. Henry A. Chase, Stoneham, Mass. The first and second claims are given:

"1. In an electric motor, two electro magnets or solenoids placed end to end, to form a long cylindrical chamber within, combined with the common hollow or tubular armature having closed ends.

"2. In an electric motor, two electro-magnets or solenoids, each composed of a spool having a tubular tapering shank and a closed end piece of magnetic material, combined with the armature movable toward and from said closed ends in the magnetic field of the said tubular tapering shank."

389,207. Electric Motor. Arthur E. Eastwick, Detroit, Mich.

389,226 Electric Railway Signaling System. Joseph Irwin, Topeka, Kan.

389,229 Electrically-propelled Vehicle. Walter H. Knight, New York, N. Y. The first and fourteenth claims are given:

"1 The combination, with a vehicle having an electric motor with variable counter electro motive force geared to its wheels, of a pawl or stop preventing backward movement of the vehicle against the motor

"14. The combination, with a vehicle having an electric motor with variable counter electro motive force geared to its wheels, of a ratchet wheel on the axle of the said vehicle and a pawl having a yielding bearing adapted to engage with said ratchet wheel, and provided with a manual controlling device."

389,230. Motor Box for Electric Vehicles. Walter H. Knight, New York, N. Y.

The invention consists in placing the motor entirely beneath the car in such manner that the armature end extends out from the axle and providing it with a boxing, which is independent of the car body.

389,254. Switch for Electric Motors. George D. Shepardson, Granville, Ohio.

389,265. Thermal Device for Varying Electric Resistance or Currents. Elihu Thomson, Lynn, Mass.

The invention consists in the combination with an electro thermo-dynamic device of any construction; such, for instance, as an electric meter, whose indications are produced through the application of heat developed by the electric current, of a thermo-dynamic actuator or controller responsive to variations of temperature in the atmosphere surrounding such meter or other dynamic device, and an electric regulator or controller adjustable in correspondence with the variations of temperature for the purpose of governing the flow of current to the thermo-dynamic device and compensating for the variations of temperature in the surrounding air.

389,272. Electrical Protective System. Edward Weston, Newark, N. J.

389,273. Electrical Recording Mechanism. Edward Weston, Newark, N. J.

389,274. Standard Tangent Galvanometer Edward Weston, Newark, N. J. The first claim follows·

"1. In a galvanometer, a hollow standard, a vibrating magnet therein, fixed supports integrally formed of said standard and upon opposite sides thereof, coils received by said supports and held in parallel planes, and means for securing said coils to said supports."

389,278. Electric Railway. Edward M. Bentley, New York, N Y. Filed Oct. 13, 1887. The sixteenth claim is given:

"The combination, with an electrically propelled vehicle and a contact device therefor movable into and out of an operative position, of a spring stop and a supplementary stop for holding the contact device in and out of its operative position, respectively."

389,279. Electric Railway. Edward M. Bentley, New York, N Y. Claims 1 and 15 follow:

"1. In an electric railway conduit, a transverse yoke supporting a slot rail and having a box or pocket at its upper end, in which is the insulator for the supply conductor.

"15. In a contact device for an electric railway, the combination, with a forked shank extending into the conduit, of a contact device pivoted in said fork, thinner than the width of the slot, and provided with a spring holding it normally at an angle to the said shank."

389,280. Electric Lamp Socket. Sigmund Bergmann, New York, N. Y.

389,281. Contact Device for Electric Railways. Josiah L. Blackwell, New York, N. Y.

389,282. Electric Railway Trolley. Josiah L. Blackwell, New York, N. Y.

The first claim is given: "1. The combination, with a suspended supply wire for an electric railway, of a contact trolley therefor, having a wheel of non-resonant material, and a supplementary contact device for maintaining the electrical connection."

389,297. Electric Lighting System. William W. Griscom, Haverford College, Pa.

The first claim is given: "1. The combination of a source of electrical supply, a series of electric lamps electrically connected thereto, a circuit closer for each lamp, and a multiple circuit closer having a series of contacts connected to each lamp circuit on opposite sides of said circuit closers operated by a single continuous movement, whereby the lamps may be included and the individual circuit closers be excluded with respect to the main circuit."

389,314. Electric Conductors and Process of Uniting the Same. Charles McIntire, Newark, N. J.

The object of the invention is to avoid the soldering process which employs acids, in making electrical connections, as is usual in connecting the wires with switch boards; the invention consists of two conducting parts and a soft metal connecting piece enveloping one of said parts and passing through the other, and compresesd to clamp the parts together.

389 337 Telegraph Relay Frederick Stitzel and Charles Weinedel, Louisville, Ky.

389,352. Alternate Current Electric Motor. William A. Anthony, Manchester, Conn , Dugald C. Jackson and Harris J. Ryan, Lincoln, Neb.

389,356. Reversing Switch and Rheostat for Electric Circuits Charles G Bickley, New York, N Y.

389,369 Incandescing Electric Lamp. Thomas A Edison. Llewellyn Park, N J

The object of the invention is to produce a multiple carbon lamp, which will have the advantage of an exceedingly high resistance at the same time that the filaments will be maintained in their proper relation to each other and to the walls of the inclosing globe.

389,421. Electric Gas Lighting Device. William Tag and Sanford C. Smith, Philadelphia, Pa.

389,423 Electro Mechanical Gong. Jacob P. Tirrell, Boston, Mass.

389,448. Electric Primer. Selden A. Day, Bowling Green, Ohio.

389,455. Electrode for Secondary Batteries. Robert M. Elliott, Washington, D C

389,526. Incandescent Electric Lamp. Frank Moore, Pittsburgh, Pa.

389,532. Battery Jar. James Serson, Boston, Mass.

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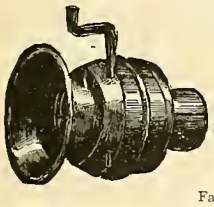

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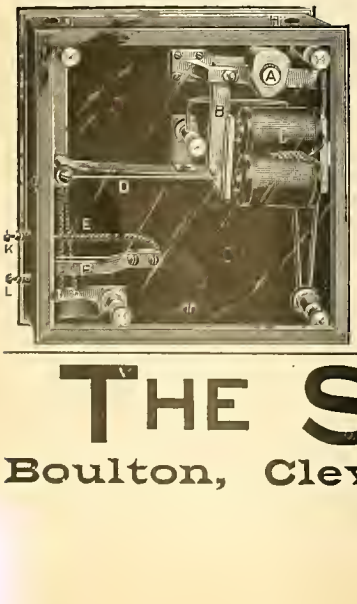

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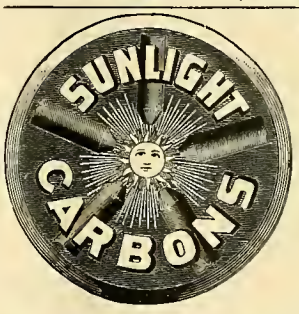

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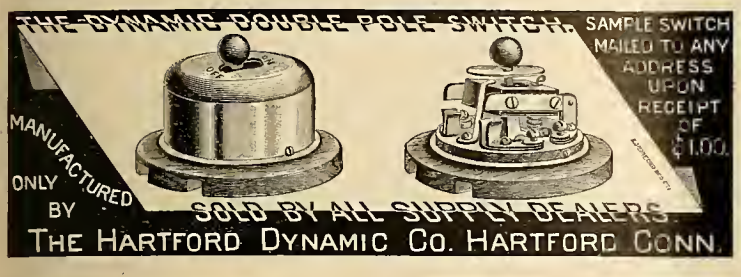

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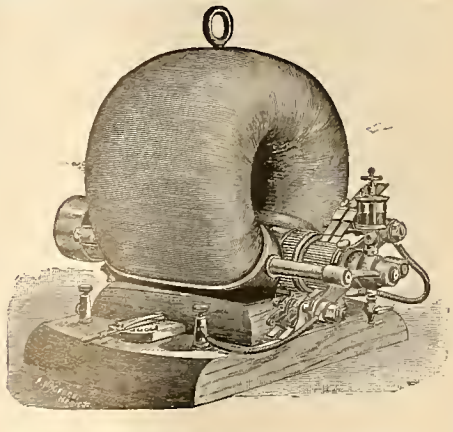

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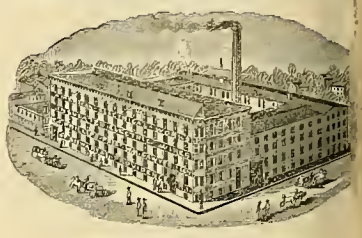
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—AND—
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A WONDERFUL INVENTION
DR. GASSNER'S DRY BATTERY,
THE BEST
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Internal Resistance, Ohms, 0.32.
Satisfaction Guaranteed.
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To be had also at
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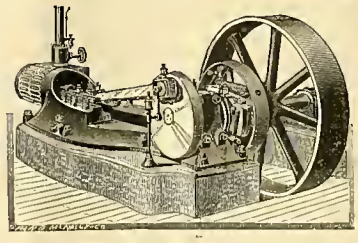

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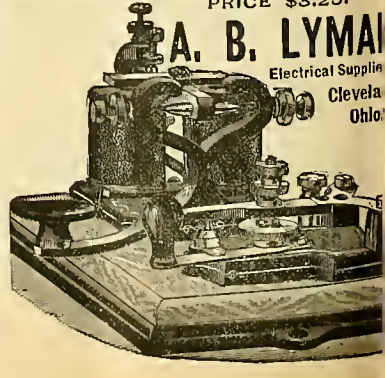

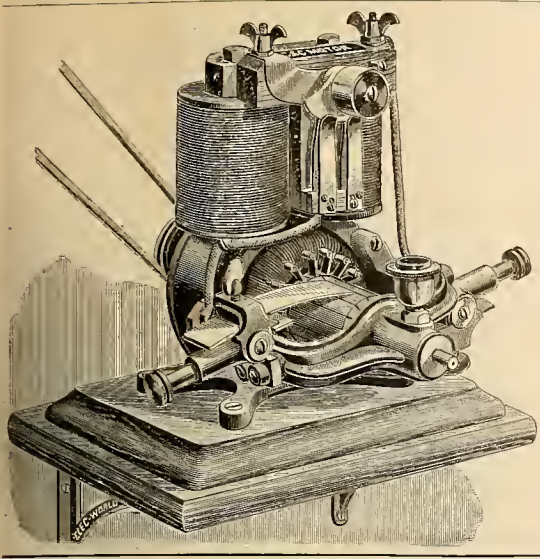

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Complete Domestic Combination Outfits:

These sets require no technical knowledge to connect; they are all contained in black highly finished hard rubber cases, mounted in nickel plate and ready for use. The bell domes are all 3½ inches, the coils are wound with silk-covered wire, and the contacts are of platinized silver.

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Our Instantaneous Automatic Regulator protects Lamps and Dynamos, and saves power. Gold Medal awarded, Mechanics' Fair, Boston, 1887, for perfection in regulation of current. Most perfect and economical System in the field.

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DO NOT BE DECEIVED

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THE CELEBRATED GONDA TRADE MARK. is the Genuine Battery.

GENUINE GONDA POROUS CELL AND ZINC.

It is unlike any other Porous Cell Battery made, or by whatever name called, and is immeasurably superior in efficiency and durability.

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Insist upon being furnished with the Genuine Gonda Porous Cell, and if your dealer does not keep it send to us direct for prices. Do not use any zinc with our cell unless it is stamped with the word Gonda.

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There will be a meeting of the ***Chicago Electric Club*** Monday evening, October 1st., at 8 o'clock, at the rooms of the Club, 122–124 Clark street.

GILES ANTI-MAGNETIC SHIELD FOR WATCHES.

Office of Van Depoele Electric M'fg. Co.
Chicago, Feb. 16, 1886.

Anti-Magnetic Shield & Watch Case Co.

Gentlemen: — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good timekeeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

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Electrician, V. D. P. E. M. Co.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

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The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and inoperative on account of their susceptibility to the all-pervading magnetic influence.

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Sure protection from all Electrical and Magnetic disturbances. Send for descriptive circular.

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LIST of SALES of WESTINGHOUSE ENGINES

COMPOUND, STANDARD AND JUNIOR, FOR THE MONTH OF AUGUST, 1888.

Alleghany Co. Light Co. (16th order), Pittsburgh, Pa.	150	H. P.,	Cp.
" " " " (17th "), " "	150	"	Cp.
" " " " (18th "), " "	150	"	Cp.
O. & C. B. Ry. & B. Co., Council Bluffs, Ia.	150	"	Cp.
Va. E. Lt. & P. Co. (3d order), Richmond, Va.	150	"	Cp.
" " " " (4th "), " "	150	"	Cp.
Colorado Elec. Co. (9th "), Denver, Col.	150	"	St.
" " " (10th "), " "	150	"	St.
St. L. & San Franc. Ry. Co., Springfield, Mo.	125	"	Cp.
Cheney Bros., S. Manchester, Conn.	125	"	St.
" " (2d order), " "	125	"	St.
Pittsburgh Refining Co., Pittsburgh, Pa.	125	"	St
O. & C. B. Ry. & B. Co. (2d order), Council Bluffs, Ia.	100	"	Cp.
Westinghouse Elec. Co. (12th order), London, Eng.	100	"	Cp.
St. L. & S.F. Ry. Co. (2d order), Springfield, Mo.	100	"	Cp.
Gd. Trunk Ry. Co. (6th order), Montreal, Can.	75	"	St.
" " " (7th "), " "	75	"	St.
Bryden Horse Shoe Co., Catasaqua, Pa.	75	"	St.
Wyatt Park Ry. Co., St. Joseph, Mo.	75	"	St.
" " " " (2d order), " "	75	"	St.
Baldwin Loco. Works, (9th order), Philadelphia, Pa.	65	"	Cp.
Quaker City Dye Works, Philadelphia, Pa.	60	"	St.
M. E. Lt. & P. Co. (4th order), Morristown, N. J.	60	"	St.
Norwich E. L. & P. Co., Norwich, N. Y.	60	"	St.
Pencoyd Iron Works (4th order), Philadelphia, Pa.	50	"	Cp.
Darlington Ginning & Mill Co., Darlington, S. C.	50	"	Jr.
Tate & Sons, Braymer, Mo.	50	H. P.,	Jr.
Dealer, San Francisco, Cal.	50	"	Jr.
A. B. Bary (4th order), Moscow, Russia.	45	"	St.
Forestdale Mfg. Co., Providence, R. I.	45	"	St.
Nova Scotia Steel Co., New Glasgow, N. S.	35	"	Jr.
St. L. & San F. Ry. Co. (3d order), Springfield, Mo.	35	"	Jr.
Foster Bros., Atlanta, Ga.	35	"	Jr.
Waverly Stone Co. (2d order), Holland, Mich.	35	"	Jr.
Dealer, Dallas, Tex.	35	"	Jr.
J. W. Schadewald & Co., Minneapolis, Minn.	35	"	St.
Lincoln Iron Works. (2d order), Rutland, Vt.	35	"	St.
Anton Schollmeier, Pine Bluffs, Ark.	35	"	St.
Cum. & Pres. Mills, (5th), Cumberland Mills, Me.	35	"	St.
The Crown Mills, (2d), Marcellus, N. Y.	35	"	Jr.
Washington Gas Co., Washington, Ind.	35	"	St.
Darl'gt'n Gin'g & M. Co., (2d ord.), Darlington, S.C.	25	"	Jr.
Ada Mfg. Co., Charlotte, N. C.	25	"	Jr.
Paesaic Print Works (2d ord.), Dundee, N. J.	25	"	Jr.
G. H. Nichols & Co., (5th ord.), New York.	25	"	Jr.
McArthur Bros. (2d ord.), Danbury, Ct.	25	"	Jr.
Canton Steam Pump Co., (2d ord.), Canton, O.	25	"	Jr.
Burrell Chemical Co,, Newberry, Mich.	25	"	Jr.
" " " (3d ord.), Newberry, Mich.	25	"	Jr.
Dealer, Dallas, Texas.	25	"	Jr.
Lawrence Mach. Co., (25th ord.), Lawrence, Mass..	25	"	Jr.
Bryden Horse Shoe Co., (2d ord.), Catassqua, Pa.	25	"	Jr.
Chambers, Turner & Layton, Truro, N. S.	25	H. P.,	St.
R. Mackintosh, Lundy, Utah.	25	"	St.
Oil Well Supply Co., Pittsburgh, Pa	25	"	St.
Keating Imp. and Mch. Co., Beckville, Tex.	15	"	Jr.
Dealer, Dallas, Tex.	15	"	Jr.
Etherton Oil Mill, (2d ord.), Etherton Ga.	10	"	St.
Betts Street Furniture Co., Cincinnati, O.	10	"	Jr.
American Glucose Co., Peoria, Ill.	10	"	Jr.
" " " (2d ord.), Peoria, Ill.	10	"	Jr.
" " " (3d ord.), " "	10	"	Jr.
H. McMorran, Port Huron, Mich.	10	"	Jr.
Westinghouse Elec. Co. (13th ord.), Pittsburgh, Pa.	5	"	St.
Chambers, Turner & Layton, Truro, N. S.	5	"	Jr.
Dealer, San Francisco, Cal.	5	"	Jr.
" " "	5	"	Jr.
S. Bethlehem Gas & W. Co. S. Bethlehem, Pa.	5	"	St.
Penna. R. R. (10th ord.), Camden, N. J.	5	"	St.
Lawrence Mach. Shop, (36th ord.), Lawrence, Mass.	5	"	St.

SUMMARY.

12 Compound Engines, aggregating	1,440	H. P.
27 Standard " "	1,590	"
31 Junior "	740	"
Total, 70 Engines, aggregating - -	3,770	H. P.

Note the Repeated Orders. Note the Character of Customers. Note the Distribution of Trade. Note the Volume of Business, and Draw your own Conclusions.

THE WESTINGHOUSE MACHINE COMPANY, - - PITTSBURGH, PA.

The Woodbury

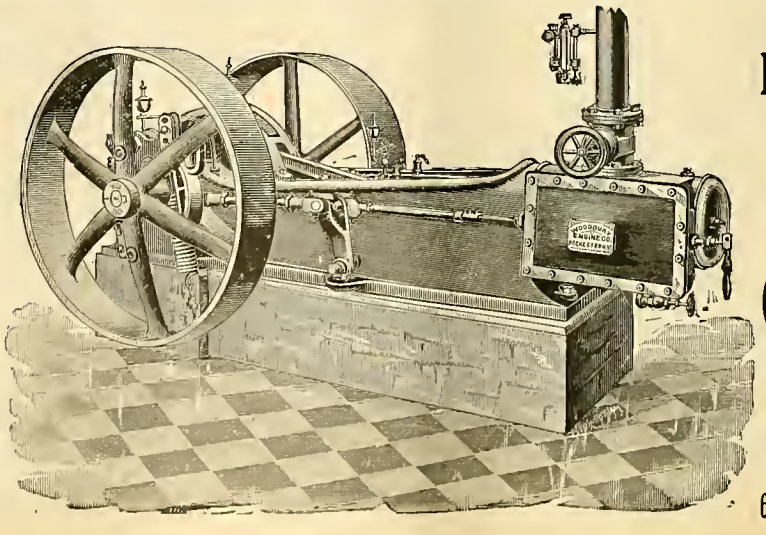
AUTOMATIC

Cut-Off High Speed

ENGINE.

——— MANUFACTURED BY ———

WOODBURY ENGINE COMPANY.



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PLAIN SLIDE VALVE

—AND—

Double Valve Medium Speed

AUTOMATIC

Cut-Off Engines

—AND—

TUBULAR BOILERS.

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Dynamo and Cylinder Oils.

Second to none. Free from gum or acids. Especially adapted for all fast runnning machinery. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

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Electrical Apparatus and Supplies,

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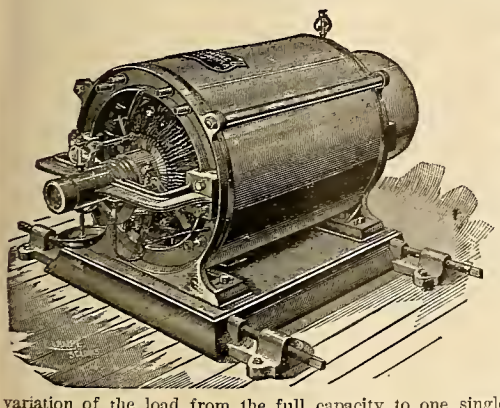
The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

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TO READ

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Can be kept continuously in circuits, either alternating or straight.

Do not Require Recalibrating.

30 to 120 V. Instruments in Stock, **$65.00.**

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VITRITE CAPS OR HOLDERS

In any size, capacity or shape of bulbs.

LAMPS FITTED TO ANY CAP

THAT MAY BE SUPPLIED.

Special Prices Made for Large Orders.

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Pending Re-organization of this Company, the works are carried on by

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Half-Size Cut of Standard Size and Shape.

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YOU
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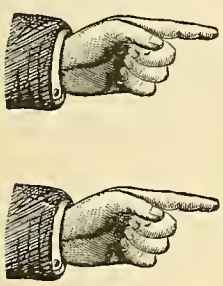
See our Catalogue, and send us your orders for tools. First-class tools, suitable for your work, will not cost you as much as you are now paying for inferior tools.



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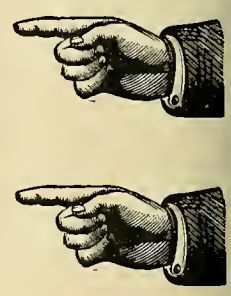

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PROMPT SHIPMENTS.
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Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

ELECTRICAL ACCUMULATORS or STORAGE BATTERIES,

Especially Adapted to

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Isolated Lighting, Railroad Car Lighting,

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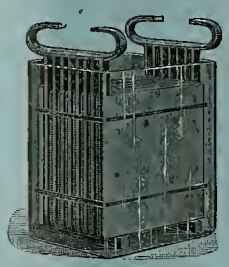

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Absolute Certainty of Light,
Increased Life of Lamps,
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Office of
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Sterling Pump Works.
MANUFACTURERS OF
IMPROVED WOOD PUMPS.

Sterling, Ills. March 26 1888.

Van. DePoele Electric Mfg. Co
Chicago Ills

In reply to yours of

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We consider your system the best most durable and economical in use. Its Lights are steady, reliable and brilliant and gives the best of satisfaction to our patrons – Your gentlemanly treatment of us at all times as well as the perfect satisfaction your system gives makes it a pleasure to send this testimonial to your long list

Yours
Wm McCune & Co

"THE BEST, MOST DURABLE —AND— ECONOMICAL."

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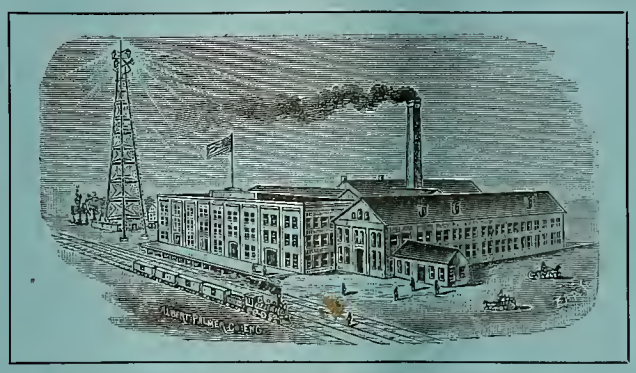
JENNEY ELECTRIC LIGHT CO.

Fort Wayne, Ind.



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The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12--16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.

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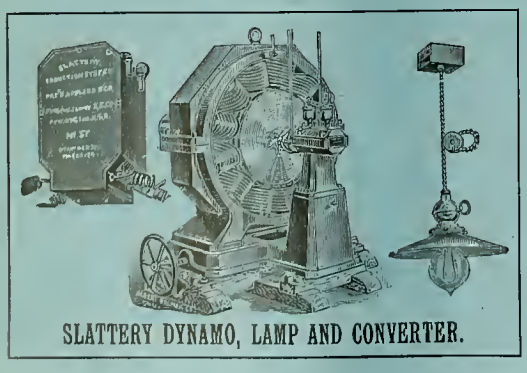

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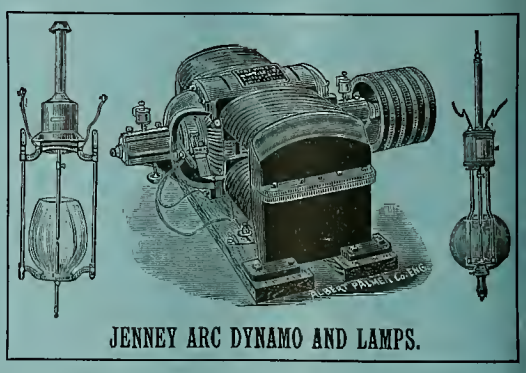

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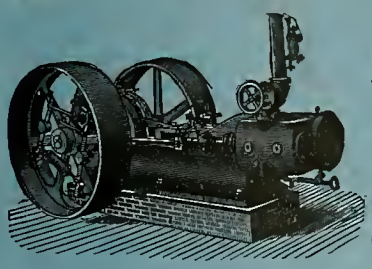

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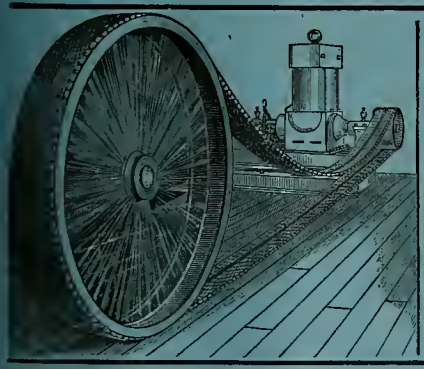

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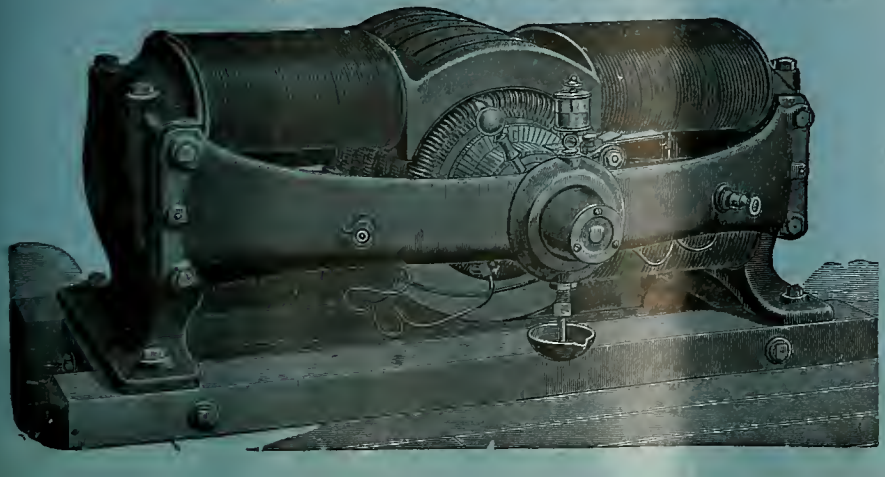

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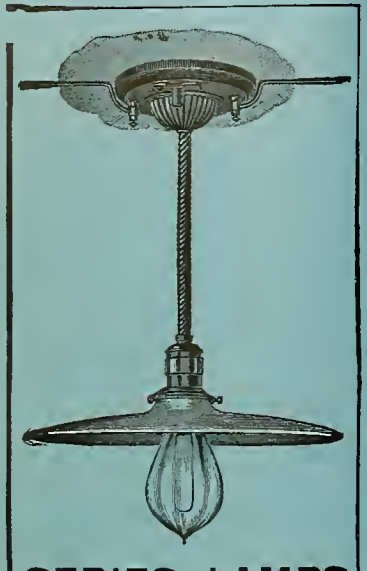

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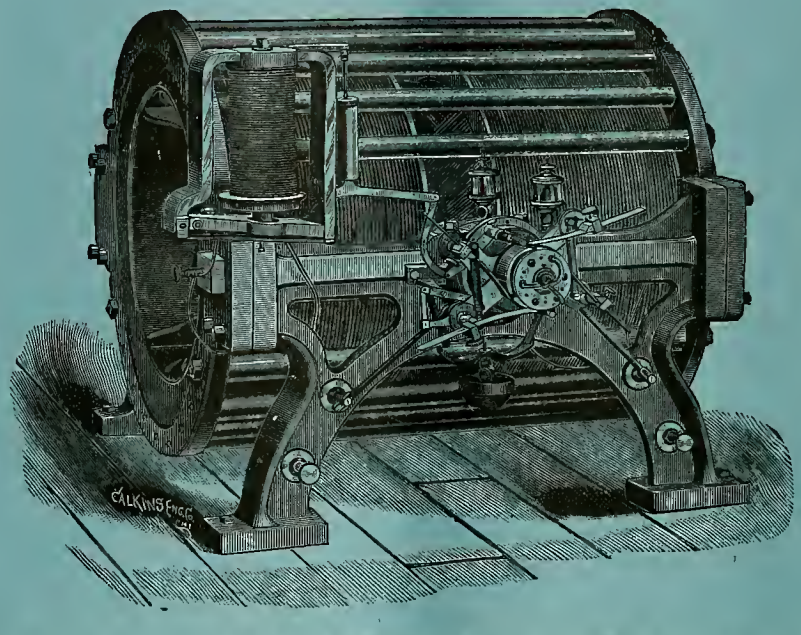

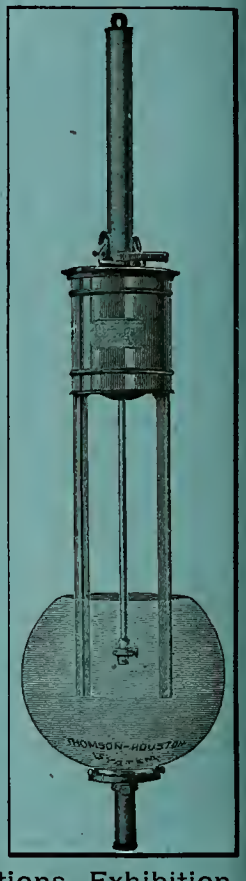

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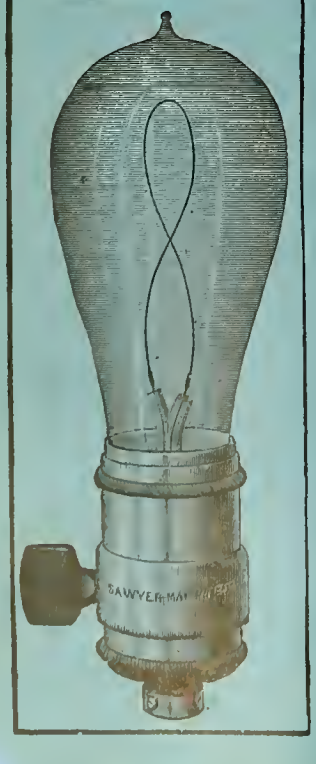

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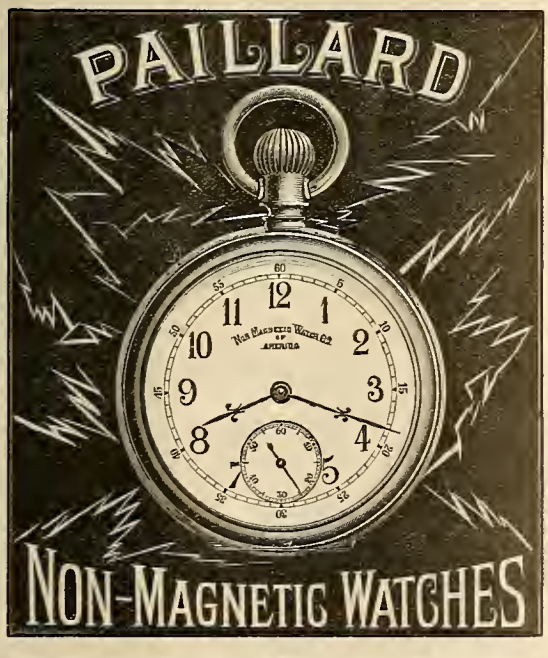

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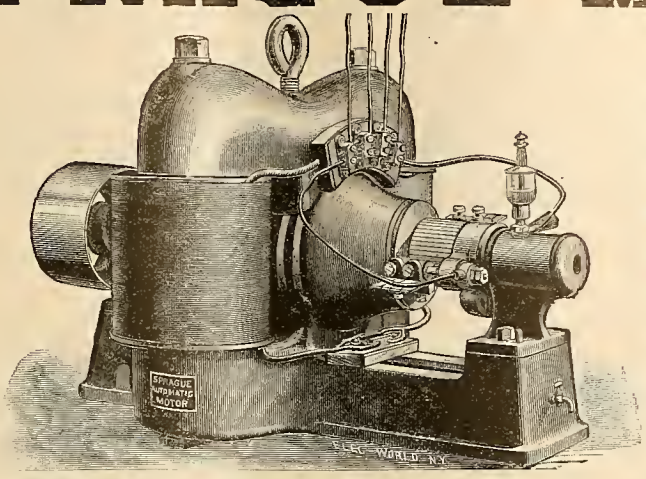

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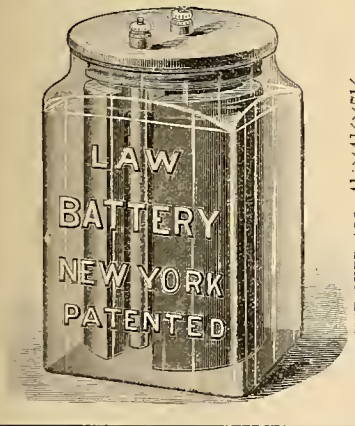

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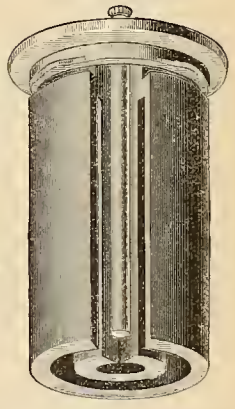

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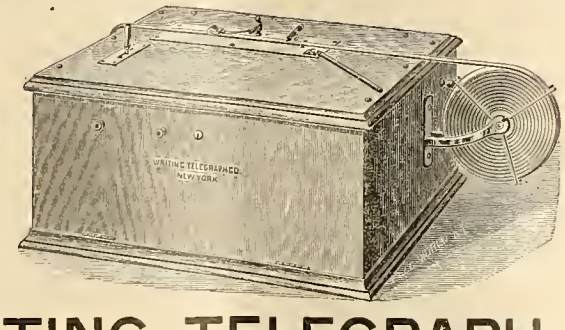

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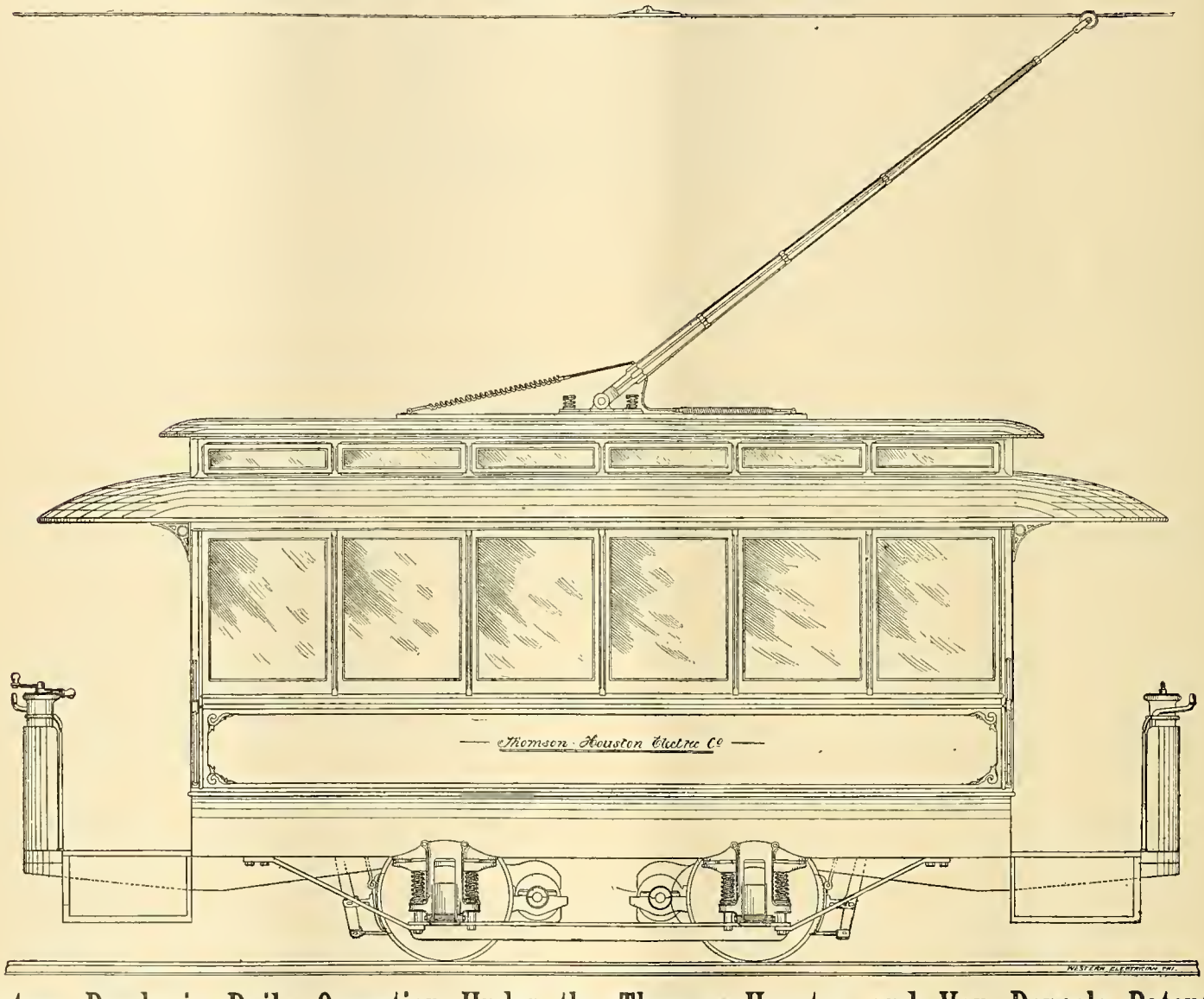

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Vol. III. CHICAGO, SEPTEMBER 29, 1888. No. 13.

The Waterhouse Automatic Regulator.

In Fig. 1 is represented a diagram of the Waterhouse type of dynamo with a closed circuit armature *A*. On the commutator *C* are three brushes; *a* and *b* are the main circuit brushes and *c* the auxiliary brush. From the positive brush *a* the current passes to the conductor around the field magnets *F* to resistance *R*. The current from the auxiliary brush *c* passes directly to the resistance *R*, leaving the field magnets out of the circuit. The current from field and local circuits joins at *R*, and passes to the lamps, the current on the lamp line being the sum of the two. The amount of current in the field and local circuits is in proportion to the resistance *R* in each. The brushes have a fixed position.

There is in every dynamo a point of maximum commutation on the armature which changes with the resistance on the lamp line, moving with the rotation toward brush *c* when the resistance decreases and back when it increases. This affects the current in the local and field circuits as follows: When lights are turned out the line resistance is decreased and the maximum point moves forward and forces more current out of brush *c*, and less out of brush *a*. This reduces the current in the field magnets and the e. m. f. in the circuit, and consequently the power required to operate the dynamo. But the current on the lamp line remains constant, because the local circuit is increased proportional to the decrease of the field circuit. The remaining lamps therefore retain their full brilliancy, while the current cannot increase and destroy the apparatus. Thus the very tendency of the machine is to perfect regulation without the aid of a mechanism, but when to this is added the simple regulator, which makes the regulation instantaneous by assisting the current to pass out at brush *c* and opposing its passage around the field magnets by way of brush *a*, when lights are cut out and forcing it out at brush *a* around the field magnets by opposing its passage out at brush *c*, when lights are cut in, the efficiency of the method can be appreciated.

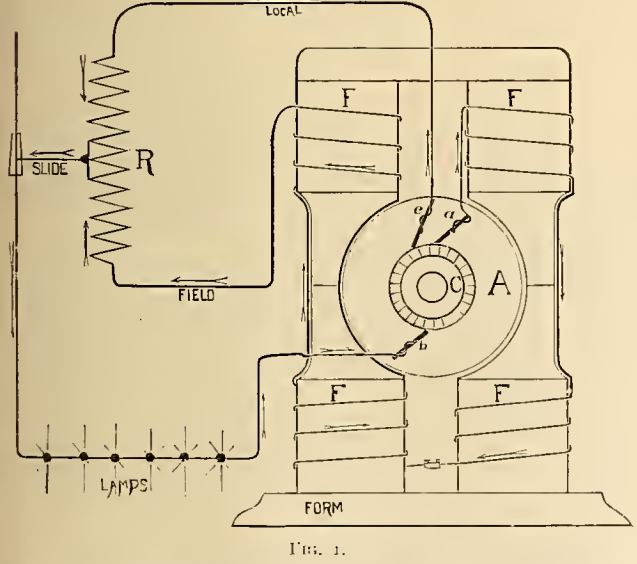


FIG. 1.

The regulator is illustrated by the slide in the diagram, which is controlled by a solenoid. Any tendency of the current to increase raises the contact, and the result is a decrease of resistance in the local circuit and an increase of the resistance in the field circuit. More current will therefore flow through the local circuit and less through the field circuit. The generating capacity of the dynamo is instantly reduced, and any tendency to produce a current over the standard is overcome. Should the tendency of the current be to decrease, say by a reduction of the speed of the armature, the slide lowers, increasing the resistance in the local, and reducing it in the field circuit. More current will then flow around the field magnets and less out on the local circuit. The generating capacity of the dynamo will therefore increase to maintain the current at standard. It should be stated that the use of resistance for balancing the field and local circuits is a small amount compared to that used by the lamps and is not interposed as can be seen for the purpose of compensating for lamps turned off.

This regulator varies the e. m. f. directly with the resistance of the lamp line, producing self-regulation and maintaining on the lamp line the standard current, whether one lamp or the full number is burning. By this method as the lamps are cut out the current is reduced in the dynamo even to the fraction of an ampere and it is apparent that one light on the Waterhouse dynamos can be maintained any length of time without producing more than the standard current.

Fig. 2 represents the Waterhouse dynamo, to which this method of regulation applies. As a generator for motor service it is well adapted for it is of the greatest importance that the current should not build up when load is turned off and that a constant current should be maintained if high tension motors are used.

The Waterhouse system with this method of regulation shows in a marked degree all of the features of economy, a smooth running dynamo and a white, noiseless, steady light, and well represents progress in the art.

Incandescent Lamps in the Columbia Theater.

For several weeks improvements have been in progress at the Columbia theater in Chicago to prepare it for the fall opening October 1st. The house has been entirely refitted and will be one of the handsomest auditoriums in the city. One of the new features is the electric light which will assume an important part in the economy of the theater. In the arrangement and working of the lights there are many new features devised by W. J. Blackburn, the electrician of the house. The rheostats are placed in a room below the stage instead of on the stage. The main feeders terminate in copper bands. Of the three incandescent machines, one furnishes current for the house, a second for the stage, and the third for the permanent lights such as those in the lobby. If an accident should happen to one of the dynamos, the lights on any circuit can be switched on to one of the other circuits.

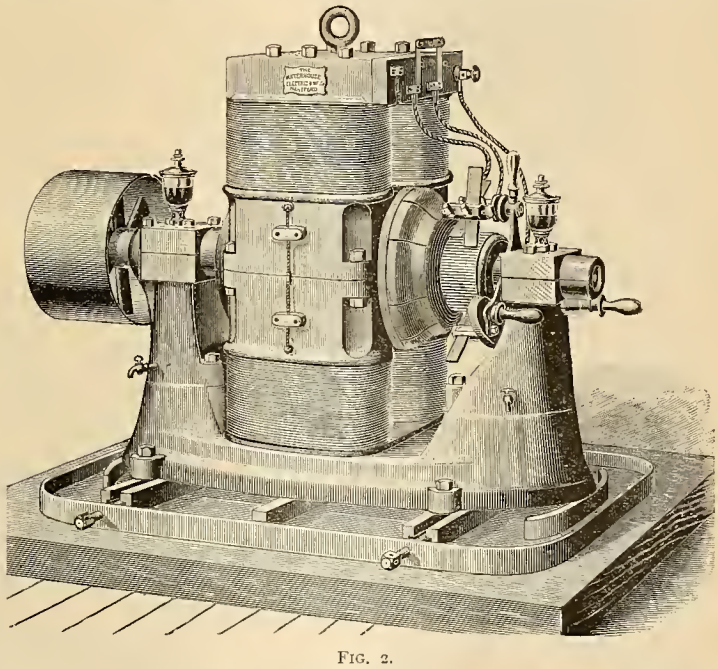


FIG. 2.

The lights from the three incandescent dynamos and one arc machine are controlled from the switch box on the stage. On the face of each resistance box are 20 segments instead of the usual number, 10. The lights can thus be toned down by almost imperceptible gradations. The footlights number sixty-five 16 candle power lamps. Red, white or green globes can be employed as the scene requires. There are five borders, each of which contains forty 16 candle power lights. The gaslights and incandescent globes are on a combination board, designed by Mr. Blackburn, so that the former can be used if any accident should happen to the electric light system. Six bunch lights, each composed of eighteen 32 candle power lamps, are used on the stage. It is hoped that by their use calcium lights may be dispensed with. These lights complete the stage equipment.

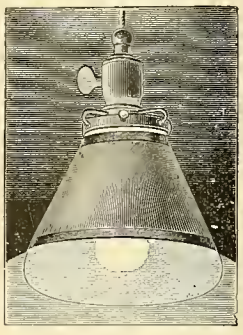
In the auditorium the lights are distributed so that they are as useful for ornamental purposes as for illumination. In the face of the sounding board are fifty-four 10 candle power lamps surrounding a single 32 candle power lamp. In the dome of the house are sixteen

10 candle power lamps and one arc light. The arc light is placed behind cathedral glass. There are six ornamental boxes on each side of the stage. The glass in the boxes is illuminated by 16 candle power lamps. The arches above the boxes are ornamented with 16 candle power lights. Six lights are placed on the face of each box. The other lights are placed where they will be most effective. The wiring of the building was done by the National Electric Construction company. The many little improvements which will greatly enhance the practical use of the lights for stage purposes were suggested by Mr. Blackburn, who is confident that the arrangement for brilliant effect will be found superior to that of any theater in the country.

The dynamos are under the charge of Engineer Joseph Kimball. The 20 light Thomson-Houston arc dynamo and a 250 light Edison machine are run by an Armington & Sims' engine. Another engine of the same make runs Edison 350 and 300 light dynamos. Improvements will probably be made in the steam plant.

Reflector Shade.

The illustration in connection shows a reflector shade made by A. A. McCreary of New York, designed for concentrating and increasing artificial light, either gas or the incandescent electric light. The shade is shaped like a bell, with convex sides, made of flint glass, each one

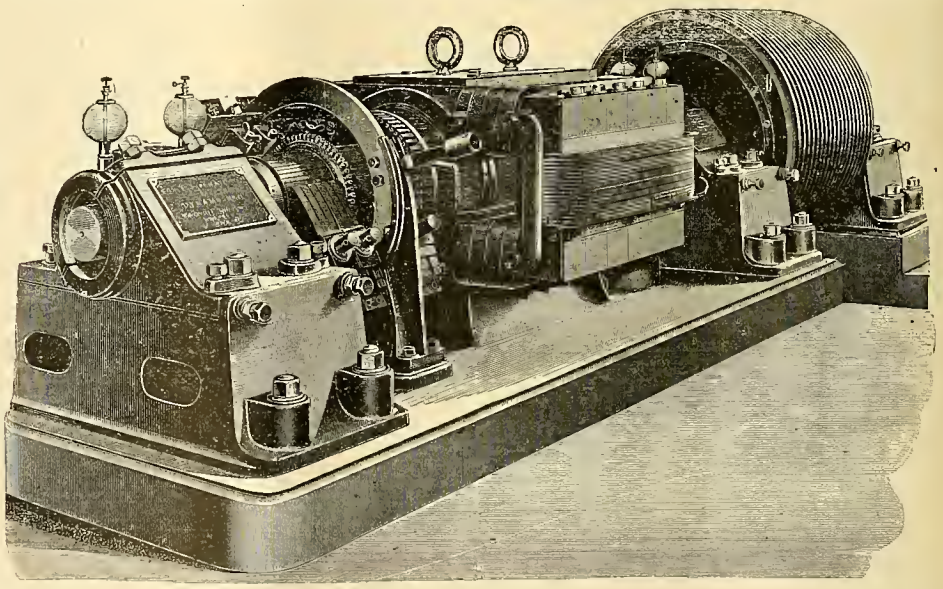


being blown separately. The whole upper surface is covered with burnished silver, laid on by hand, and the bottom is slightly convex and of ground glass. The rays from the light are thrown against the silver, and these, reflecting against the ground glass, break up all the rays, and the effect is a mass of light without direct rays. This shade can be attached with no more trouble than an ordinary globe or shade, and the effect is purely mechanical. The light is softened and whitened by its use, and as the light is increased threefold, the saving in the number of lamps used can be made very large. A most brilliant light is thrown upon everything beneath the lamp, and the most delicate colors of glass or pictures are shown to the best possible advantage.

Reduction of Refractory Ores

The employment of electricity for the reduction of refractory ores is a subject that is now receiving its share of attention from electricians. Two plants for this purpose have been contracted for recently in Denver, Col., and it is believed that more plants will be installed in a very short space of time when the great advantages of the electric current for this work are more widely known. A plant of prominence in America for this purpose is the Cowles plant at Lockport, N. Y., where aluminium and its alloys are manufactured. There one of the largest, if not the largest, Brush machines in the world is in operation. The parent company is the Cowles Syndicate company, near Stoke-on-Trent, England, where a similar process is carried on, but a different dynamo is used—a Crompton machine. A description of this dynamo, taken from *Industries*, is of value to all electricians working in this department:

The dynamo illustrated in connection was manufactured by Messrs. Crompton, and is said to be the largest machine in England. It has been designed for an output of 5,000 amperes at 60 volts' pressure when running at 380 revolutions per minute. It is a very compact and handsome machine of the horizontal double horseshoe type, and has a drum armature wound with bars of naked copper insulated from the core and from the driving horns by mica. The end connections are made according to a method patented by Mr. Swinbourne. The section of conductor is ⅝ inch by ¾ inch, and there are 128 bars when counted all round the armature, and these are connected with sixty-four commutator strips by screws, no soldering being used. It will interest electricians to learn that this method of connection, which is adopted also in other parts of the machine, has proved perfectly reliable, notwithstanding the fact that the machine occasionally carries 6,000 amperes. The bars are placed edgeways on the core, and are connected in groups of four, so that the winding is electrically equivalent to an armature having thirty-two external conductors and sixteen commutator strips. The subdivision of each conductor into four has been adopted in order to reduce as much as possible the tendency to heating from eddy currents, which, with a conductor 1½ inches wide, would be excessive. Even with this subdivision there is still a certain amount of heating, but this is quite within safe limits. The machine works now almost continuously night and day, and what heat there is generated by eddy currents and resistance is carried off by an air blast from a Schiele fan. The machine, when we saw it at work, gave about 5,000 amperes at a pressure of 60 volts; but occasionally the current would rise as high as 6,000 amperes. The core of the armature is 20 inches diameter by 36 inches long. The magnets are 37 inches by 6 inches cross section, and compound wound, with the main preponderating. The machine is almost a series dynamo, pure and simple; but a shunt has been added to facilitate the starting, when, with the furnace cold, the resistance in the external circuit is necessarily large. As will be seen from the illustration the shunt coils are wound on the yokes and the series coils on the horizontal limbs of the magnets, there being four turns on each limb, but only three of them in circuit. Each shunt coil contains 250 turns, and the shunt current is about 50 amperes when in regular work. In the furnace house there is a rheostat by which the furnace men can, within certain limits, vary the shunt current and the



pressure given by the machine, and to facliti at quick starting there is a switch on the dynamo by which the two shunt coils can be placed into parallel. The main coils are all in series, and the total exciting power when in regular work is therefore about 42,000 ampere turns. The current is taken off by four brushes on either side. These brushes are attached to the large ring, clearly shown in the illustration, and by means of a long bar placed into the socket, also shown, a man keeps the brushes during the run to the non-sparking point. The smaller ring surrounding the commutator serves as a strengthening piece to the sections, which, owing to their great length, require some additional support. The driving power is transmitted to the armature conductors by forty-eight driving horns of aluminium bronze. The current coming from the dynamo is led by copper bars to an enormous cut-out, and from there to the furnaces in the adjoining room. A huge current indicator is inserted into the circuit in order to enable the attendants at the furnace to judge of the progress of the operation, and to keep the current within certain limits, by adjusting the distance between the electrodes. The current indicator is simply a solenoid of nine turns through which the current passes, and into which is placed an iron core suspended from a spring. The move ment of the core is made visible by a pointer playing over a large dial, and the axis of the pointer is carried through the wall, so that the indications are repeated on a second dial in the engine room. The electrodes can be withdrawn or advanced by means of a screw and handle, and a boy on each side of the furnace watches the current indicator, and manipulates his electrode so as to keep the current as uniform as possible.

The construction of the furnaces is exceedingly simple. Each furnace is a rectangular pit, constructed of fire clay, and provided at either end with an inclined cast iron pipe, through which the electrode is introduced. The current is supplied by the two copper bars running horizontally across the furnaces, and by flexible cables, which can be clamped to the bars in any desired position. Only one furnace is running at a time, the other furnaces being meanwhile either charged or left to cool. Each electrode is a bundle of from seven to nine carbons, each 2½ inches diameter, around which is cast a cylindrical head of iron when ferro-aluminium is to be produced, or copper when aluminium bronze is to be produced. A stout copper rod is attached to the center of the head, and projects through the cover of the cast iron pipe already mentioned, and to the outer ends of these rods are clamped the flexible cables pending from the omnibus bars overhead. The furnace is charged as follows: On the bottom is thrown a layer of limed charcoal; the electrodes are then inserted, and two pieces of sheet iron connected by stirrups, and forming the sides of a bottomless box, are then put in to serve as a temporary receptacle for the charge of ore, metal and charcoal, while the spaces between the sheets of iron and the longitudinal walls of the furnace are filled with charcoal, after which the sheet iron box is withdrawn. To start the current a few broken pieces of carbon are thrown into the furnace so as to bridge across between the electrodes, and the whole charge is then covered with a top layer of charcoal, and the furnace is closed with a cast iron cover provided with a hole in the center, through which the gases generated during the process escape. These gases are ignited and burn with a white or slightly purple flame. At first, and shortly after turning on the current, the gases given off are mostly hydrogen and oxygen; but when all the water has been driven off the combustible gas is chiefly carbonic oxide, the carbon being supplied by the charcoal and electrodes, and the oxygen coming from the ore. With careful manipulation one pound of contained aluminium can be produced for every three pounds of the ore used.

The Writing Telegraph.

By W. E. Gump.

There has been no lack of copying telegraphs, commonly called autographic, which telegraph a copy of the writing or sketch submitted to them; but the system of telegraphing *fac simile* letters or characters while forming them with the stylus of the transmitter, so that they are reproduced by a receiving pen, was first made public by Edward Alfred Cowper, a well-known engineer of Great George street, Westminster, England. The instruments were publicly exhibited by him at the meeting of the Society of Telegraph Engineers, on Wednesday, February 26, 1879, before one of those overflowing audiences which assemble there only on great occasions.

It has always seemed strange to me that this ingenious apparatus, which constituted the first real autographic telegraph, and at that time took rank with the brilliant series of telegraphic marvels, which from time to time engaged the attention of the world, has never been described in any of the many books on telegraphy which claim to give a history of the art from its conception to the present time. In these books you will find inventions of automatic and so-called autographic telegraphs duly recorded in order, and described in detail, but no mention whatever of the only invention which could properly be called autographic. Doubtless it was due to this silence that this system did not sooner receive the attention of inventors, for Mr. Cowper surely pointed the way.

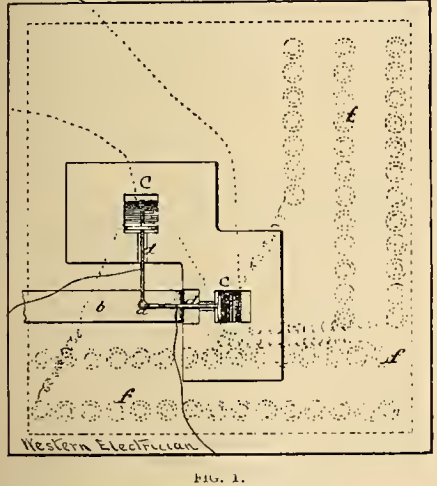


FIG. 1.

The principle which guided Mr. Cowper to a solution of the problem was that of "compounding the movements of a point in two directions, the one at an angle to the other, the actual movement of the point being the resultant of the two movements." This method Mr. Cowper has the honor of first applying to a writing telegraph and, so far, it has proved the only known method of writing by telegraph. Mr. Cowper effected this by employing two separate telegraphic circuits, each with its own wire, battery, sending and receiving apparatus. One of these circuits he made to transmit the up and down component writing of the pen's motion while the other simultaneously transmitted its side long component. Each continuously varying component was transmitted by causing the resistance of the circuit to vary with the component in question.

The diagrams illustrate the actual apparatus. Fig. 1 is the plan of the sending instrument and Fig. 2 an elevation of the same; *a* is the writing style which is held in the writer's hand in the ordinary way, while he shapes the letters one by one on paper pulled uniformly underneath by clock work. To *a* are attached two arms, *d d*, one for each circuit. Each arm, *d*—the one insulated from the other—is connected to its particular battery, the other pole of the battery being connected to earth. Each arm, *d*, is fitted with a sliding contact at its free extremity, and as the stylus, *a*, is moved in writing, these contacts slide lengthwise across the edges of the two series of thin metal contact plates, *c c*, insulated from each other. Connected between each pair of these plates, there is a resistance coil, *f*, and the last of these is connected through the last plate to the line wire. As *d* slides outward across the plates, the current from the battery has to pass through fewer coils, since *d* short-circuits a number of coils proportional to its motion, and the fewer of these resistance coils in circuit, the stronger will be the current in the line. If the stylus or pencil makes a large stroke, there will be a strong current sent in the line, if a short one, there will be a weak one, and thus they are varied to strong or weak in accordance with the varied movements of the pencil *a*.

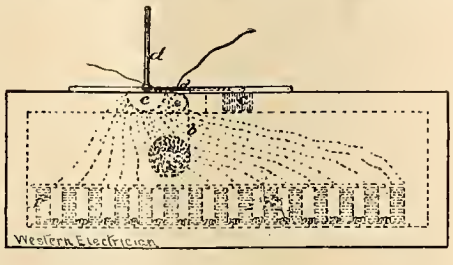


FIG. 2.

Fig. 3 is a plan of the receiving instrument, and Fig. 4 the elevation of the same; *h h* are light pivoted needles, surrounded by coils of fine insulated copper wire, *i i*, and controlled in their zero position by the electro magnets *j j j j*, placed underneath, the whole forming a pair of galvanoscopes or current detectors, one for each line. The line wires pass through the coils *i i* to earth. The writing pen *k* is connected to the nearest tip of the needle of each galvanoscope by threads *n n*, which are kept taut by the fibers $o^1 o^2 o^3$, the springs *o* and the pins o^4. Now, since the needles deflect in proportion to the strength of the current flowing through its coils, the points of these two needles keep moving with the varying currents. But since the motions of the sending pen vary these currents, the receiving pen, controlled by the united movements of the needles, will trace out a close copy of the original writing.

The electro magnets *j j j j* were magnetized by a local battery. Permanent magnets would have been a gain in simplicity, and in his patent Mr. Cowper mentions this way. The next improvement Mr. Cowper submitted to the public was in making the movements of the style or pen reproduce greater or less strength of current by bringing into the circuit a greater or less number of battery cells. By still another method, he effected the variation in the strength of currents by combining various numbers of battery cells with various resistances. The contact bars at right angles to each other and worked by the sending pen, were made to slide in guides and have two projections on their under side, one sliding over a set of contact plates connected to the resistance coils, and the other projection sliding over a set of contact plates connected to the battery cells, so that as the operator would write, battery cells were added, and resistance coils left out of the circuit when greater power was wanted, or battery cells were left out and resistance coils taken into the circuit when less power was required.

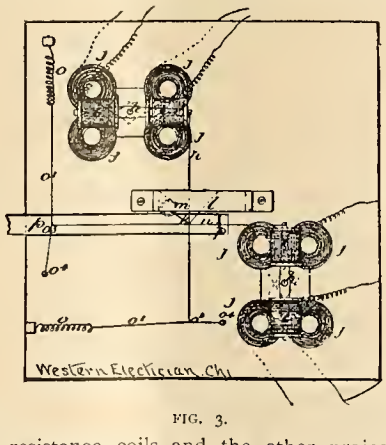
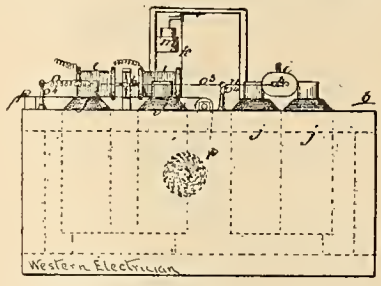


FIG. 3.

His receiver was changed to that of a single movable soft iron bar or needle, to which the pen was connected, suspended before two fixed electro magnets situated at right angles to each other, through the coils of which electro magnets, the varying currents of the two circuits were made to pass. Another plan was by pivoting or suspending the pen itself, and having fixed on it a piece of soft iron exposed to the varying attraction of the electro magnets in the two directions, acting in opposition to springs, pulling it in opposite directions. The pen used was a siphon pen, the shorter leg of which dipped into an ink reservoir.

The arrangement of the electro magnets and springs are shown in Fig. 5: The pen fits in the central hole of the disk *b*. This disk is of soft iron, and acts as an armature to both electro magnets, *d e*, placed at right angles to each other; *f f* are the fine springs which supply the necessary resistance to the pen against the pull of the magnets, the pen being connected to those springs by the threads $f^1 f^1 f^2 f^2 f^3 f^3$, the last two of which are attached to the post f^4. The paper *g* upon which the message is written by the siphon pen, was moved by clock mechanism.

Mr. Cowper shows various modifications of armatures and pen attachments. Another style of his receivers is shown in Fig. 6. In this receiver the armature *u* was a bar of soft iron of a tubular section. This armature he called the needle. It held the siphon pen *t*, which had its longer leg passed in through a hole in the side of the needle, and projected out through another hole at the lower extremity of the same. The shorter leg of the siphon dipped into the ink reservoir *W*. The needle armature was supported by a fixed bracket *V*. This bracket projected into the interior of the needle, and at its extremity supported the needle from a steel point, which was fixed in the axis of the needle.



The side of the needle where the bracket entered was cut away, so that the needle when thus supported was free to move in any direction. Stationary coils of wire X^1 X^2 surrounded the needle, one at each end. These coils were of sufficient internal diameter to permit the required movement of the needle, and kept the needle constantly magnetized by means of a local battery with which they were connected. The set of stationary electro-magnets *y y* ^1y ^1y were placed in circuit with one of the line wires, and consequently always acted together.

Their poles were so arranged that when the needle was polarized they all united to deflect it to an inclined position in the same plane in which they were placed. There was a similar set of magnets connected to the other line wire, and precisely similar in their arrangement and action, which were placed in a plane at right angles to the plane of the set described. Springs and threads similar to those shown in Fig. 5 were used to give the necessary resistance to the needle against the pull of the magnets. The pen as stated was pivoted and in order that it could more easily traverse the surface of the paper, the paper when the pen moved over it was given a concave form corresponding to the arc in which the pen moved, by passing the paper under a bent form with a hole through it of sufficient size to allow of the largest movements of the pen.

A different device had for its object, the raising of the receiving pen from the paper when the operator ceased to write. This was done by attaching the pen support by means of a thread to a spring controlled by an electro magnet, through the coils of which one of the circuit currents was made to pass. While writing, the thread hung inoperative, but when the currents were caused to cease by raising the sending pen on the completion of the word or character trans-

[1]Read at the stated meeting of the Franklin Institute, Wednesday, September 19, 1888.

mitted, the spring released by the magnet raised the pen out of contact with the paper, thus causing each word to be written separate from the other, as in ordinary writing. There are different ways mentioned by Mr. Cowper for accomplishing this same object. It may interest the public to know that among his claims for a patent, Mr. Cowper broadly covers "the combination with a receiving pen of means for lifting the same from the paper when the circuit is broken." The patents of Mr. Cowper also broadly cover the method of writing by means of a varied current. These patents were purchased by the Writing Telegraph company, of New York.

The writing produced on the instruments of Mr. Cowper was of a slightly nervous, tremulous character, but "not sufficiently marked to prevent the handwriting of the person at the transmitting instrument from being readily recognized." The instruments were operated successfully over a ninety mile circuit. The instruments were expensive, could scarcely write twenty words a minute, were delicate in many parts, the contacts were liable to corrode, and there were many things to perfect to make it practicable for commercial use.

J. Hart Robertson next appears in this line of invention. Familiar with many of his experiments and assisted by data furnished by him to the Writing Telegraph Company, I am enabled to state the most prominent of his experiments and devices, which stand as mile posts on the inventive road to a successful writing telegraph instrument. It is but just to Mr. Robertson to state that when he first devised his writing telegraph, he was not aware that Mr. Cowper or any one else had ever made any invention of the kind. Mr. Robertson necessarily operated on the same principle of "compounding a point in two directions, the one at an angle to the other," as demonstrated by Mr. Cowper, but the devices for accomplishing the work began far in advance of where Mr. Cowper permitted his experiments to end. Not that his results were obtained at once for, in reality, they were the outcome of experiments, the majority of which were very discouraging. Mr. Robertson's first transmitter consisted of two sets of metal contact plates placed at right angles to each other as shown in Fig. 7. These plates were insulated one from the other and connected electrically by means of wires connected with resistance coils. Instead of the sliding contacts of Mr. Cowper's instrument, the stylus acted as the contact maker as it moved over the contact plates when writing. This stylus had two points, one passing over strips *a*, and the other over strips *b*. The two points of the stylus had springs so as to allow a free movement of the hand, without breaking contact between the stylus points and the metal strips.

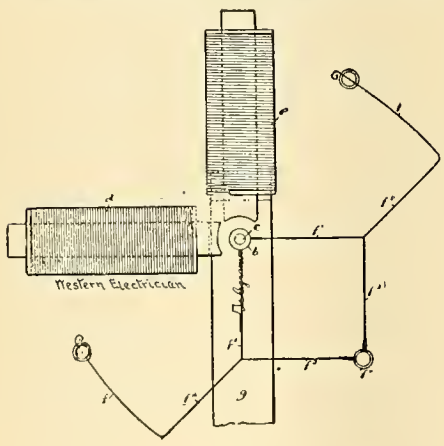


FIG. 5.

The battery was conducted to the contact points by means of flexible wires attached to the top of the stylus, and passing through it. It will be readily seen that as letters are formed on the contact slips, the two currents are varied, and their varying movements thus actuate the properly constructed receiver and cause its pen to reproduce the movements of the transmitting stylus. It is not expedient to illustrate the remaining parts of this instrument at this time. Sufficient to state, that it was designed to write on stationary paper, which moved or not, as was desired, when the pen was lifted. The pen could be lifted to cross the t's and dot the i's, the writer controlling these movements through his transmitting stylus, as well as feeding the paper forward or upward a certain definite distance as required. The action of lifting or laying down the stylus also automatically connected the transmitter or not, as the case might be. The receiver was always in circuit. The lines for the receiving pen had to be short, owing to the fact that the further the writing extended to the

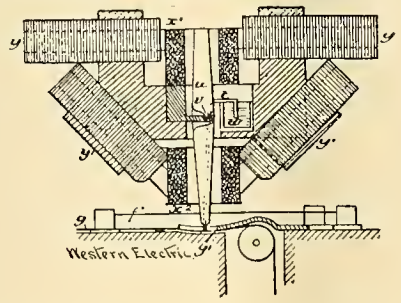


FIG. 6.

right, the more it would be up hill and the letters be distorted accordingly. Mr. Robertson states that this defect is inherent in every writing telegraph receiver in which a single point is fulcrumed to two others at an angle to each other, and thus makes it impossible to reproduce writing on stationary paper in lines of any length, without thus distorting it to a certain extent. It is partially remedied by increasing the distance of the fulcrumed point from the two others sufficient to allow of a larger radius. Sometime afterward, however, he got over the difficulty by fastening the magnet that gave the movement in one direction, together with its complete adjusting device, on the armature of the magnet that gave the movement at right angles to the first. By this means writing can be produced in lines on stationary paper without being distorted and in an exactly straight line, as the two connecting levers always move at right angles to each other, no matter in what part of the field the writing takes place. While the writing on this instrument was a fair reproduction, Mr. Robertson was not satisfied with its "irregular or wavy character," which he termed "jerky." This he expected to remove by a proper adjustment of contacts and resistances,

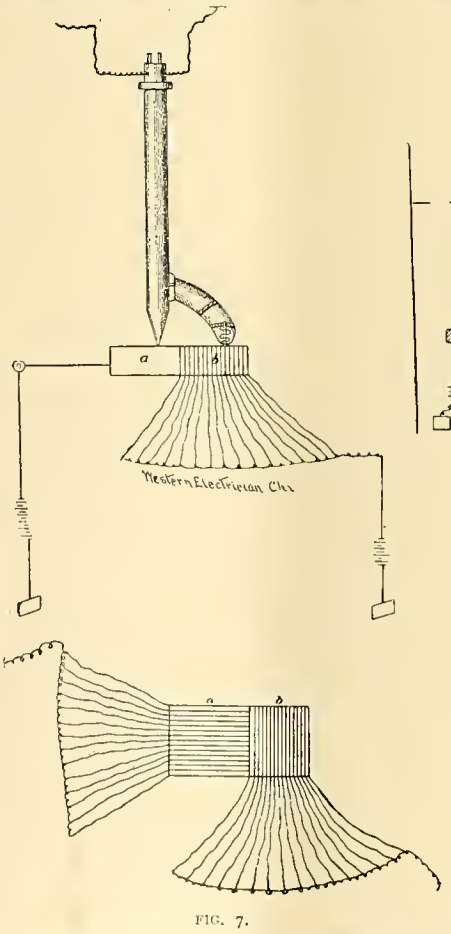


FIG. 7.

The instrument was not as simple as he wished, and Mr. Robertson avoids any complex mechanism. About this time he learned of Mr. Cowper's invention. He then sought to get a varying movement, more gradual than by "step by step." Care was taken to protect the invention as it had proceeded. His researches showing the great and gradual range of resistance obtained by pressing pieces of carbon together, he soon invented his first carbon transmitter, which, with mechanical changes suggested by experience, is the same as the one used to-day. This transmitter has forty carbon disks, Fig. 8, one-half inch in diameter and one-fortieth of an inch thick in each series, which were placed at right angles to each other. A screw follower was afterward added on each cylinder which, contained the disks, which served to bring the disks in better contact, and which allowed the maximum resistance proportional to that of the line to be quickly adjusted. It seems needless to add that the pressure on these series of disks produced by the stylus in writing took the place of the contacts with their resistance coils, and gave Mr. Robertson the gradual variation he sought. The first receiver constructed by Mr. Robertson to work with this transmitter was constructed as shown in Fig. 9. It consisted of two magnets fastened under the base, and at an angle to each other. Above each was freely suspended a very light, soft iron armature. One was influenced by what we term the "up and down" and the other by the "right and left" magnet. A pen carrier was pivoted to the former and partook of an "up and down" motion from it. The right and left motion it got from the other armature to which it was connected by a silk fiber.

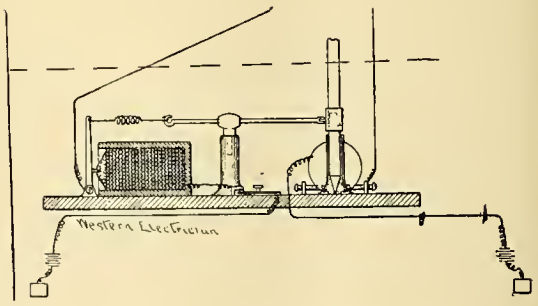


FIG. 8.

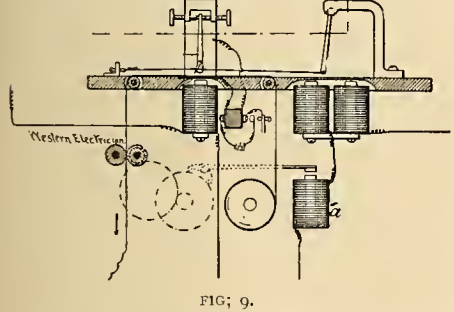
The armatures were suspended from permanent magnets, which gave enough polarity to them to be repelled by like poles of the electro magnets, and attracted by the opposite, the object being to get as large a movement as possible. It was found that the movement was at the expense of power and speed, and the friction on the trunnions working at right angles to each other, was objectionable for rapid writing.

The pen was a small tube of aluminium, weighing only two grains. This proved too great a friction on the paper and the idea of a pen and ink reproduction with this receiver was given up for a different plan of writing with it. A light platinum-pointed needle was used for a writing stylus and was suspended so that the point was about one-thirty-second of an inch above the paper which moved beneath it. One end of the secondary wire of a local induction coil was connected to this needle and the other end was fastened to a metal plate over which the paper moved. As the needle reproduced the movements of the writing stylus, the induced current from the needle to the contact plate discolored the paper on its passage through it. The magnet *A* was used to control the movement of the paper. The paper was made to start or stop at the option of the writer. The words could be disconnected and the t's crossed by automatically cutting the induction coil out or into the circuit. The paper was a dry chemical paper. It took several weeks of experimenting before one could

be obtained which would discolor, without having the stylus in absolute contact with it, or without moistening the paper. The reproduction was excellent, but in the course of a couple of weeks would all fade, and this was considered fatal. The next receiver is shown in Fig. 10. It consisted of a piece of soft iron, about three and one-half inches long and one-quarter of an inch square, supported on a steel rod and acting as a combined armature for both set of magnets, placed at right angles to each other. This was a more powerful receiver.

The weight of the armature being relatively great as compared with that of the fountain pen filled with ink and pivoted at the upper end of the rod, made the motion of the receiving stylus more easily controlled. Thus one improvement led to another. On this receiver the reproduction of an "up and down" or "right and left" movement was perfect. The writing, except for its wavy character, was a good reproduction; but when it came to the full reproduction of an angle between the two movements ⁄, only half of the line could be made. Mr. Robertson attributed this to the "magnetic lines of force," conflicting with and partially neutralizing each other when the armature was in a certain position, and from that sprang his idea of two armatures, magnetically insulated and pivoted on the same rod.

There were yet two defects to be overcome. One Mr. Robertson termed "eliminating the jumping point of the armature." This is explained in Fig. 11. As the strength of a magnet is gradually increased, the armature will also be gradually and evenly attracted until it reaches a certain distance from the magnet, as shown by the letter *e*, when its speed will increase in a much greater ratio than from *f* to *e*. Many expedients were tried to overcome this and utilize



FIG; 9.

the space between *e* and *g*, but it was only by detracting from some other feature. The other defect alluded to, was the tremulous "wavy character" of the writing. He sought to overcome both difficulties by constructing his armature, as shown in Fig. 12, to pull downward as well as toward the poles of the magnet. Although there was power lost by this downward pull it was more than compensated for by the steadier action gained. There was still a trembling of the receiver rod at the slightest jar or vibration, and if the operator did not have a very steady hand, the writing would show it very decidedly. A very simple but very important improvement removed this final defect. This improvement was simply immersing the armature or its extension in a vessel containing a liquid.

The first trial made was with the single armature, which moved in a cup of mercury, and although the amplitude of the movement of the armature was small, owing to the large body of mercury used, the improvement was so apparent that experiments were continued until the present cup of glycerine and its float attached to the armature rod, as shown in the pamphlets published by our company, was perfected and adopted. Now every mark is clear and distinct, and not a vestige of tremor. With the advent of the liquid cup, the fact was demonstrated that almost any kind of armature gave good results, in combination with it, and that if it had been used at the start a great deal of time spent in experimenting would have been saved.

From this point progress was more rapid and the result is the practical commercial instrument described and illustrated in the pamphlets issued by our company. Mr. Robertson also varied the transmitting currents by immersing electrodes more or less in liquid. Fine carbon spirals specially prepared by him were also tried and gave fair results. A comparatively small carbon spiral will give all the resistance necessary. Mr. Robertson got a minimum resistance of four and one-half ohms out of a piece of carbon twenty-five and one-half inches in length, which measured 145 ohms when the convolutions were not in contact. It was made into a flat spiral, large enough in diameter to require only five convolutions. It was one-eighth of an inch wide and one-thirty-seventh of an inch thick.

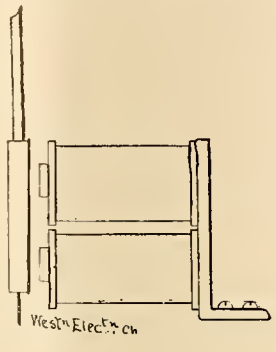


FIG. 10.

Our company has had a great deal of trouble in obtaining uniform carbon. Whether sawed from carbon rods and then rubbed down, or moulded in disks and then finished, there was a great variation in their resistance. Carbon disks, one-half inch in diameter and .05 of an inch in thickness, after carefully smoothing off each surface and placing some thirty of them in a superficial contact under a pressure of fifteen pounds, would give a total resistance of hundreds of ohms, and every lot would greatly vary. Under these conditions sufficient difference of resistance could not be obtained to operate all instruments alike.

Harry Etheridge, a young electrician of great promise, was given the problem to solve, to make each transmitter uniform. Each carbon disk was taken separately, subjected to a constant pressure, and its resistance obtained. The pressure was applied superficially and equaled about eight pounds. Under this pressure some disks would show .1 ohm, another .6 ohm, another 2., another 15. ohms, and so on, many reaching the extraordinary amount of 800. ohms. From this data it was readily seen why thirty disks, taken at random and arranged in series, varied so much in resistance. With care and experience in preparing carbons, they are now all made of low resistance, the majority less than .2 of an ohm, and none are used above that resistance. In this way our transmitters at Pittsburgh are adjusted to a minimum resistance of five ohms and a maximum of 150 ohms. Guided by these measurements of resistances in carbons and their resistance as the stylus rod is pressed against them in every movement of about one-twentieth

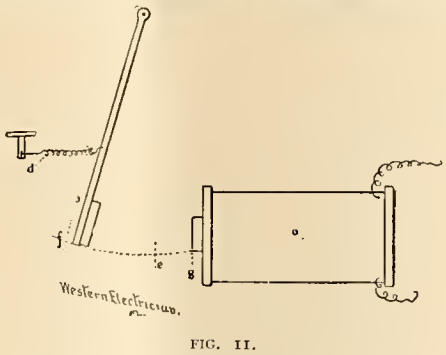


FIG. 11.

of an inch or less, Mr. Etheridge became convinced that he could construct a transmitter without carbon, which would always prove constant. Several made by him proved failures, but perseverance and the benefit of experience at last succeeded. The Etheridge transmitter bids fair to earn a prominent rank among writing telegraph transmitters. The stylus is arranged to press against a series of steel tongues arranged in a vertical position, and to each of which is connected a suitable resistance. The upper end of these tongues is tipped with platinum, and as they are compressed and expanded, the resistances are thus "cut in" or "cut out," respectively. The resistances are composed of German silver wire. It is a combination of the Robertson and Cowper systems, and does perfect work. It is due Mr. Etheridge to state that it is by his improvement to our exchange instruments, that we are enabled to record a message on any subscriber's instrument, whether that subscriber is present or not. The writing telegraph is yet in its infancy, and we all have much to learn about it.

Our company has not confined itself to only one style of instrument, although it has perfected what it considers the most simple and practical instrument for commercial use. At our experimental exchange at Pittsburgh we have had them in constant operation throughout the year. Through the winter's storms and the summer's heat the instrument has demonstrated its commercial practicability. A locomotive puffs with heavily loaded freight trains past our exchange, but fortunately the pen writes indifferent to any noise. We use poles in conjunction with the electric light company, immaterial as to whether our wires are above, below, or surrounded by theirs. The pen writes just the same in utter ignorance of the word induction. For six months we have had instruments in daily use in several cities, reporting base ball scores by innings. This has been so satisfactory that we are arranging to greatly enlarge the field for the coming year. We are past the experimental stage, are ready for and doing a practical com-

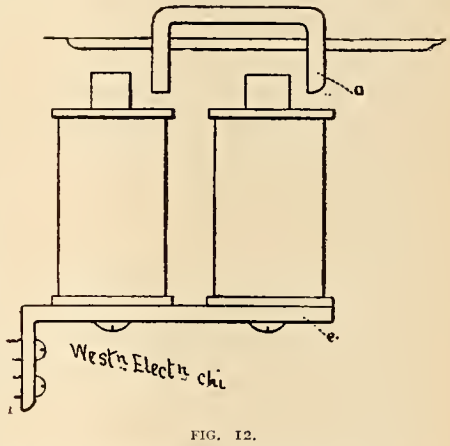


FIG. 12.

mercial business, and our company anticipates a bright future for the writing telegraph.

The Bloomington Electric Light Plant.

The contract for lighting the city of Bloomington, Ill., has been finally awarded to the Fort Wayne Jenney Electric Light company through W. J. Buckley, manager of the Chicago office. The struggle for the contract was of the most bitter character. The bidders were the Thomson-Houston company and the Fort Wayne Jenney company. The former company installed a plant in the city several years ago, on the understanding that the municipality should have the option of purchasing it. The contest over the award enlisted the interest of the citizens generally, and for weeks little else has been discussed in the city. Charges and counter charges were made in the council and the newspapers abounded in insinuations which reflected on the characters of persons directly and indirectly interested in the award. The excitement was so great that when final action was taken 500 citizens gathered in and about the council chamber to learn the result.

It was first decided to award the contract to the Fort Wayne Jenney company for $70,000; the payments to be met by the issue of city warrants. It was found that in consequence of the existing city debt this course would be illegal. It required three weeks to adjust the legal difficulties. The contract awarding the work to the Fort Wayne Jenney company was closed September 21st.

The contract calls for 240 lights. Work will be commenced at once and it is expected that the system will be in operation by November 1st. The plant will be operated in connection with the city waterworks, and a new building will be erected. All lights will be suspended from mast arms. The dynamos will be eight 30-light machines.

The Hill Clutch company will install the steam plant, which will consist of four 66"x16' boilers, and two Corliss engines of 150 horse power each. All the belts and shafting will be below the floor.

It would seem that the west side in Chicago ought soon to have rapid transit of some kind, even if it is not fortunate enough to have an electric railway. A new company, which proposes to construct an elevated road, has just been incorporated with a capital of $10,000,000. Such corporations are becoming so numerous that it is almost impossible to keep track of them.

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CONTENTS OF THIS NUMBER.

	PAGE
The Waterhouse Automatic Regulator, Illustrated	167
Incandescent Lamps in the Columbia Theater	167, 168
Reflector Shade, Illustrated	168
Reduction of Refractory Ores, Illustrated	168
The Writing Telegraph, by W. E. Gump, Illustrated	169, 170, 171
The Bloomington Electric Light Plant	171
Editorial	172
The Babyhood of Telegraphy—Bernard O'Connor and Prof. Morse, by James D. Reid, Part II	173, 174
Chicago Telephone Matters	174
New York Board of Electrical Control	174

DEPARTMENTS.

Correspondence	174, 175, 176
Electric Light	176, 177
The Electric Motor	177
The Telephone	177
The Telegraph	177
Electrical Patents	178

A CORRESPONDENT in Bremen, in this week's issue, points out some of the distinctive features of the electrical field in Germany. The letter is thoroughly informal, as the writer intended it should be, but the communication is not less interesting on that account.

AMONG the faithful men who have remained at their posts during the yellow fever epidemic at Jacksonville, the telegraph operators should not be forgotten. They have been obliged to work laboriously under the most trying circumstances. The importance of their work can hardly be overestimated, and their services deserve hearty recognition.

MR. CROMPTON'S huge dynamo, designed for the manufacture of aluminium and its alloys, is an interesting piece of mechanism considered by itself on account of its unusual features. Further than that its description at this time when considerable attention is being paid to the manufacture of dynamos of low electromotive force, but of great quantity for electric welding, electro-plating, and the reduction of refractory ores, is particularly apropos.

GEORGE TICKNOR CURTIS has written to an eastern paper correcting an erroneous impression concerning the bill to establish a court of patent appeals, the full text of which has heretofore been published in these columns. In his letter Mr. Curtis says:

"Permit me to say, therefore, that it is the purpose of the bill to have the court of patent appeals settle finally all the controverted facts in patent cases, and that an appeal to the Supreme court shall carry up nothing but the questions of law arising on the facts so found. This is one of the express provisions of the bill, and its chief advantage will consist in the time that it will save in the Supreme court for other suitors, who now are subjected almost to a denial of justice by the delays caused by the overcrowded docket of that court. A very great amount of the time of the judges of the Supreme court is now consumed in settling disputed facts in patent cases, which might just as well be determined finally by another tribunal, leaving the Supreme court to settle the law, if the parties wish to have it done."

A SKETCH of the electric light plant in the Columbia theater, Chicago, is given in this issue. The subject of theater lighting is one of great importance and it is beginning to attract the attention it deserves. With one or two exceptions all the prominent theaters in Chicago are now lighted by electricity, and the change has been found advantageous in every particular. The brilliancy of the electric light makes it incomparably superior to gas for stage effect, and the greater ease with which the lights are manipulated is a great point in its favor. For the body of the house electric light is far better than gas, as it is in all places, for that matter.

THE board of management of the Chicago Electric club met, as announced, a week ago last Thursday evening, and after some discussion of the advisability of establishing a club house, adjourned until Monday evening of the current week without calling a meeting of the club. At the meeting Monday evening the club house committee was continued with instructions to confer with the real estate men, and if possible get an option on a house suitable for the needs of the club.

It is the unanimous opinion that the time has come when the club should have more pretentious quarters, and most of the members seem inclined to be satisfied with nothing less than a club-house of their own. The committee will report as soon as possible and lay before the board all the figures they can obtain relating to the expenses of the club if established in a house of its own.

The following entertainment committee was elected: W. A. Kreidler, chairman, C. D. Shain, C. A. Brown, C. C. Haskins and B. E. Sunny.

IT is necessary sometimes to go a long way from home to learn local news. The London *Electrician* of recent date contains the following paragraph: "In France the question of long distance telephony wears a somewhat different aspect from what it does in this country, owing to the fact that while the local exchanges are chiefly in the hands of private companies, the trunk lines have been built by the government. At present the Paris-Marseilles line is only available from the head offices, and the high tariff of three francs for three minutes' (or five, the accounts differing) conversation is charged. The daily papers are speaking of this line as the longest hitherto built for telephonic purposes. As a matter of fact, the distance from Paris to Marseilles is only about three-quarters of that from New York to Chicago, which cities have been for some time in telephonic communication."

No one in Chicago has known of this telephonic connection between New York and Chicago. The long distance line is building, but communication has not been opened yet.

THE introduction of petroleum into Chicago by the pipe line of the Standard Oil company is a matter of considerable interest to every large consumer of fuel. That electric light companies are greatly interested in the subject of petroleum as a fuel was evidenced by the discussion which followed the paper of S. S. Leonard at the convention of the National Electric Light association. Mr. Leonard is a thorough believer in the use of petroleum for fuel, and the large manufacturers are kindly disposed toward it if reports are to be believed. There seem to be objections to its use in Chicago, but the one insuperable obstacle is the determined opposition of the insurance men who raise rates wherever it is employed. The delivery of oil at the South Chicago tank is about 5,000 barrels daily, but it is said that the supply can be doubled if the demand warrants such an increase. The oil is used at the South Chicago steel works, and the proprietors of several other establishments at that place are considering the question of substituting petroleum for coal. The introduction of oil in the brick kilns, it is said, has reduced the running expenses greatly.

Those who have used the petroleum fuel, as far as can be ascertained, heartily recommend it. H. A. Gray enumerates the following advantages which attend its use: Saving in cost, absence of smoke, uniformity of steam pressure, saving in yard room as fewer cars are needed, prevention of the working over of water into cylinders of engines. Mr. Gray also says: "We don't admit that there is any increase of risk. The insurance men talked the matter over and a few of them increased rates slightly. Mayor Roche has visited the works and thoroughly inspected them. He and other city officials are satisfied that we have taken all due precautions, and when we have come to renew our policies next spring we won't stand any nonsense from the insurance men. They claim that there is danger of the storage tanks exploding. We have two of them, of a joint capacity of 32,000 barrels, but they are hundreds of feet away from the building, and each is surrounded by a brick wall twenty feet high. We have been burning fuel since we started our works March 21st last, so you see the days of experiment are past. We do not want to go back to coal. We are now using fuel oil at our works only for making steam, but we are experimenting as to its use on ingots and blooms, and with every prospect of success. In that event we can dispense with five hundred to six hundred tons of coke a day."

Warren F. Leland, proprietor of the Leland Hotel, Chicago, at one time used oil for fuel, but discontinued it when his insurance rates were advanced. Of the experiment he was perfectly satisfied. He said: "It is the cleanest and the best fuel in every respect that I have ever used. I saved $5 a day in fuel and more than 5 per cent. in damage to furniture by smoke and soot. There was not a whiff of odor, except, perhaps, for a few minutes when the tank was being filled. I am firmly convinced that a street tank, well bricked up, and having a vent pipe leading to the top of the building to carry off the vapor, could not be made to explode if the hottest kind of a fire was built directly underneath. It is by all odds the prettiest fuel for hotel use."

One of the firm of P. D. Armour & Co. spoke in the same strain, as follows:

"We were well satisfied with it. But the insurance companies raised the rates so that we did not think it advisable to adopt it as a regular fuel. We still have it in contemplation, however, and regard it as the fuel of the future. In a recent conversation the president of the Michigan Carbon company of Detroit told me his company had been using the oil for some time, and it had given the best of satisfaction.'

The attitude of the insurance companies is defined by William R. Kerr, one of the members of the committee of the board of underwriters, which condemned its use. He said: "In our report to the board—which was unanimously adopted and made a rule—we recommended that no underwriter should take a risk on property where fuel oil was used unless the owner had a permit from the commissioner of public works, and the building had been inspected by the superintendent of survey of the board of underwriters, even then only at an advance of 1 per cent. on the regular rates. The penalty for each offence was fixed at $100. There was a provision in the rule, however, under which an agent might write a policy, under all proper restrictions, when the fuel oil used was 300 per cent. proof, the same as is required in New York. But I understand there is no such oil in the Chicago market. Every property owner in the city is as much interested in this question as the underwriters. We want safety, and so do they. The only difference is that we are expected to protect them against fire as well as against loss by fire. If the Standard Oil company or any other company will devise a way of storing and burning the oil with comparative safety, we shall not be found standing in the way. But the burning of a foundry at San Francisco, involving a loss of nearly $200,000; of a woolen mill at Minneapolis, with a loss of $150,000, and the glass works on Fortieth street, near Clark street, just south of Chicago, all through the use of fuel oil, admonishes us to take all possible precautions."

The Babyhood of Telegraphy.

BERNARD O'CONNOR AND PROF. MORSE.

BY JAMES D. REID.

Part II.

Notwithstanding these experiments of Dr. Watson in the middle of the last century, Prof. C. A. Steinheil of Munich, in 1838, claimed it as his own, and Mr. Shaffner in his "Manual of Electricity," with his usual facility, grants the claim. Nor, indeed, are such claims to be lightly regarded. Steinheil's discovery may have been made in entire ignorance of what Dr. Watson had previously done. This is true in the case of thousands of patents, which have enriched others than the original inventor, and yet were honestly due and honestly obtained. No patent or claim for the discovery of the earth as a conductor, and capable of utilization as a return wire, was ever issued in America. The correspondence between Mr. O'Reilly and Prof. Morse was on a totally different subject, which is made clear by Mr. O'Connor's reference to Prof. Morse's article published in the Baltimore *Clipper*.

How Iron Wire Came to be Used.—It is well known that the first wires erected were of copper, and no doubt seemed for a time to be entertained of the necessity of using that material, even though other metals were known as conductors. So far, the telegraph projectors were without any experience and little knowledge to the contrary. Yet copper was expensive, and in its usual condition at that date, weak and easily broken. Added to this its value caused it to be readily stolen whenever the wire was exposed to depredation. Indeed, the disasters from such causes were so frequent that the line between Lancaster and Harrisburgh was abandoned, and, through my intimacy with Professor Morse, and acquaintance with Alfred Vail and Hon. Amos Kendall, I became the superintendent, *pro tem.* of the line of the Magnetic Telegraph company, then partly completed between New York and Washington. It happened one day when some very important news from abroad had been received, that the wire leading out of Philadelphia was found to be out of order and by certain signs, well known now, we judged the trouble to be very near. Accompanied by my companion in the office, afterward one of the true heroes of the battle of Gettysburg, Gen. S. K. Took, we started out and found the wire broken near Callowhill street, and part of it carried away. I attempted to buy enough copper wire at the stores near me to mend the break, but could find none. Finally to make the connection, as a desperate expedient, I bought and used a coil of small iron stove pipe wire and then hastened back to see the result. Rejoiced exceedingly to find the circuit restored and ready for business, I immediately acquainted Mr. O'Reilly and President Amos Kendall with the fact, and from that information it was determined to use iron wire instead of copper. This was the subject of Professor Morse's article in the Baltimore *Clipper* referred to by Mr. O'Connor.

Professor Morse's Impertinence.—The impertinence ascribed to Professor Morse I never heard of, although intimate with both, neither do I believe it possible of proof in any such connection. Professor Morse was the most polite of men, and of calm and unruffled temperament. Mr. O'Reilly, of all men, was the least qualified to address any one on purely electrical matters; he was a man of much ability, but never in that direction. He was polite but impatient of restraint, and vindictive. However, he could quickly see the value of the substitution of iron for copper wire and at once adopted it. There was friction between these gentlemen afterward when Mr. O'Reilly undertook to break the professor's patent, but Professor Morse in defending his rights never forgot that he was a gentleman

Although I was thus the means in this incidental way of bringing about the adoption of iron wire I could not, of course, claim it to have been an original discovery, original though it was to me and those about me. The conducting power of various metals was known long before I or any of us were born. In the existing state of general knowledge, however, it was valuable. It led to the vastly increasing reliability of telegraphic transmission and gave great impetus and success to telegraph line building and the formation of companies.

Did Professor Morse Invent the Telegraph?—The interview with Mr. O'Connor now has to do with Professor Morse's claim as an inventor:

"Professor Henry stated that Professor Morse obtained his patent through a drawing he had of a telegraph instrument. He had a workman make a model from this drawing, and the mechanic could not get the model to work until he had come to him and had several explanations. He also said that Morse could not explain the instrument at all."

The charge that Professor Morse was unable to explain his own instrument, at once places this strange narrative on a plane so low as to be vile, and utterly discredits all of real interest in the story. It is too idle for treatment. Professor Morse was for a long time on intimate terms with Professor Henry, although at a late period in their lives they became unfriendly. The following letter of Professor Henry will settle in all just minds Professor Morse's claim to his invention by the one man in America who knew best of all others its identity and value:

PROFESSOR HENRY'S ACKNOWLEDGMENT.

PRINCETON COLLEGE, February 24, 1842.—About the same time with yourself, Professor Wheatstone of London and Professor Steinheil of Germany, proposed plans of an electro-magnetic telegraph. These differ as much from yours as the common principle would well permit. Unless some essential improvements have lately been made in these European plans *I should prefer the one invented by yourself.* With my best wishes for success, I remain with much esteem, JOSEPH HENRY.

I go back however still further, and give any doubter of Professor Morse's claims the following letters from Amos Kendall and Professor Henry, which it appears to me should be final:

LETTER FROM AMOS KENDALL.

WASHINGTON, December 1, 1847.—*Dear Friend Reid:*—While Professor Morse was in Europe in 1838-39 Professor Henry borrowed Professor Morse's ten mile roll of experimental wire of Dr. Gale who had it in charge for the purpose of experimenting upon electro-magnetism at Princeton. On his return, Morse wrote to Henry approving the loan of wire, and among other things inquiring whether in his experiments he had become acquainted with any fact tending to show that his plan of an electro-magnetic telegraph was impracticable.

To this Professor Henry replied as follows:

PRINCETON, May 6, 1839.—*Dear Sir:*—Your favor of the 24th ult. came to Princeton during my absence. I am pleased to learn that you fully sanction the loan which I obtained from Dr. Gale of your wire, and I shall be happy if any of the results are found to have a practical bearing on the electric telegraph.

I am acquainted with no fact which would lead me to suppose that the project of the electric telegraph is impracticable. On the contrary I believe that science is now ripe for the application and there are no difficulties in the way but such as ingenuity and enterprise may obviate. But what form of the apparatus, or what application of the power will prove best, can, I believe, be only obtained by careful experiment. I can say, however, that so far as I am acquainted with the minutiæ of your plan, I see no practical difficulty in the way of its application *for comparatively short distances;* but if the length of the wire between the stations be great I think some other modification will be found necessary, in order to develop a sufficient power at the further end of the line. I remain with much respect,

Yours, etc, JOSEPH HENRY.

This letter establishes the following facts:

1. That Professor Henry had been experimenting upon electricity with Professor Morse's wire previously used by him in New York in perfecting his plans.

2. That at the date of this letter *upward of eight years* after the publication of his (Morse's) experiments in *Silliman's Journal*, which have been largely quoted as virtually an invention of the electro magnetic telegraph, Professor Henry had no definite idea of the form of such a telegraph and supposed that there were still difficulties which it would require ingenuity and enterprise to overcome.

That supposing Professor Morse's plan to be a telegraph of a single circuit, he deemed some modification of that plan necessary when the circuit should be of great length in order to develop a sufficient power at the farther end of the line.

3. Professor Henry did not then suggest, and the inference is irresistible that he had not before suggested to Professor Morse any specific modification calculated to effect that object. Yet Professor Morse more than two years before had not only devised but actually constructed, in his combined circuit the modification Professor Henry had in 1839 thought still to be necessary, and had filed a caveat for that device more than a year before.

Professor Henry never claimed to have invented the telegraph, or the part of it which seemed essential for distant transmission. He greatly improved and enlarged the knowledge of the electro magnet and this facilitated invention. Yours truly, AMOS KENDALL.

With the full knowledge of all the facts and with these letters of Professor Henry before him it would seem that no sensible man can ever claim that Professor Morse, the uprightness of whose character has never yet been impugned, derived his conception of the electric telegraph from Professor Henry or from any drawing made by him, except as Henry, Oersted, Schweigger, Sturgeon and other scientists enlarged general knowledge in the fields of magnetism and electricity.

ALFRED VAIL.

The chief assistance ever received by Professor Morse in the perfection of his telegraph was rendered him by Alfred Vail of Morristown, N. J., with whom I was on terms of great intimacy while acting as superintendent of the Magnetic Telegraph company's lines between New York and Washington, but of whom I do not propose to have much to say in this article. Mr. Vail was a practical machinist, and had the practical talent which Professor Morse, who was an artist, needed to put his invention into shape for public use. Mr. Vail, with other gentlemen, first saw the apparatus of Professor Morse at an exhibition of it at the rooms of the New York University in 1837, and witnessed its capacity to record messages, and this led to Professor Morse's receiving him as his partner. Of Mr. Vail, Professor Morse always spoke in terms of kindness and esteem. In writing to a friend Professor Morse used the following language:

"It is especially to the attention and skill, and faith in the full success of the enterprise maintained by Alfred Vail that is due the success of my endeavors to bring the telegraph at that time creditably before the public."

The arrangement of the mechanism was Mr. Vail's special field, which, though it added nothing to any part of the invention as such, gave to it a commercial form and value. The registering apparatus arranged by Mr. Vail for the government line was good but clumsy. With his amused approval I altered the form to the shape of a harp. Its final and preferred form was given to it by Richard M. Hoe, the inventor of the fast printing press, and has never since been essentially changed. Of this and other matters I may have more to say hereafter.

GEN. ANSON STAGER.

The interview continues as follows:

"Mr. O'Connor was for many years connected with the Western Union company and was for a long time superintendent of its lines. He at one time owned more Western Union stock than any other man. He has built more telegraph lines than any other man and put up the first wire to the Pacific coast early in the '50s. It was while he was superintendent of the Western Union that General Anson Stager of this city, found employment in a telegraph office. He first gave him employment at Lancaster. The young man was bright and diligent and was rapidly promoted. He was finally placed in charge of the office at Cincinnati, and when Mr. O'Connor resigned the position of superintendent, he recommended Mr. Stager to succeed him. The company followed the suggestion and gave Stager the place."

It is not very important, but General Stager received his first official appointment to a telegraph office by me while acting as superintendent of the Atlantic & Ohio Telegraph company in 1846, long before the existence of the Western Union Telegraph company, and subsequently to the managership of the Cincinnati office of the Pittsburgh and Louisville company's lines, over which my jurisdiction had been extended. This latter office he filled with great skill and usefulness. Mr. O'Connor, as lessee of the New York and Mississippi Valley Printing Telegraph company's lines, afterward Western Union, through Ohio and Indiana, and inducements held out to him by the board at Rochester, N. Y., led to General Stager's leaving my employ

in 1852, and entering a career in the service of the Western Union Telegraph company which brought him much wealth and influence.

I close with an extract from Professor Morse to a friend before relief came to him from Congress, and brought to him his final success.

MORSE'S FIGHT WITH POVERTY.

"No one can tell the days and months of anxiety and labor I have had in perfecting my telegraphic apparatus. For want of means I have been compelled to make with my own hands, and to labor for weeks on what a good mechanic could have made in one-tenth of the time. Nothing but the consciousness that I have an invention which is to mark an era in human civilization and which is to contribute to the happiness of millions would have sustained me through so many and such lengthened trials of patience in perfecting it."

It was no small man who wrote these ringing words.

(*Concluded.*)

Chicago Telephone Matters.

In the last issue of the WESTERN ELECTRICIAN mention was made of a petition asking the city council to reduce telephone rates. It was also stated that merchants were asked to sign an agreement to pay $5 or $10 in case the council took the desired action. In reference to this question President Phillips of the Telephone company said:

"Alderman Ernst, the chairman of the committee, said that he had a petition before him which contained 3,000 signatures of our subscribers asking that telephone tolls be reduced to $75 per year. I told him that it was all right; that I did not blame the people for wanting to have the prices reduced, but that we could not do it and exist. But I told him also that a great many of the people who had signed this petition had also signed notes for from $5 to $10 to be paid when the ordinance reducing the price should be adopted. Now 3,000 names at $10 each would be $30,000. That was certainly a great deal of money for paying the expenses of bringing a petition before your body. Alderman Ernst said that such action looked like blackmail and that it ought to be examined into, but there was nothing of that kind indicated in the petition. That was all there was said."

The petitions mentioned were circulated by S. C. Kanter and F. W. Schwartz, says the Chicago *Herald*. Kanter is the son of Max Kanter, who loans money on chattel mortgages at 5 per cent. a month, and has an office at 34 North Clark street, where he acts as attorney for his father. Schwartz is the secretary and cashier of the Riverdale Distilling company. Kanter said that the idea of getting the signers to the petition to also sign notes of from $5 to $10 originated with Mr. Schwartz, to whom it was suggested by several of the telephone subscribers who wanted the rates reduced to $75.

"We only obtained 2,000 names," said Mr. Kanter, "and there are only a few notes for $10 each, and some for only $2, but most of them are for $5. The money was not intended as a corruption fund, but for the purpose of defraying our expenses. If the rates are reduced from $125 to $75, then we are to be paid, but not otherwise. We do not depend upon the passage of the ordinance alone, but upon the court's decision afterward. We had twelve men out getting the signatures, and that cost us something. We lose what we have paid out if the rates are not reduced. If they are reduced, we will make enough to pay expenses, and whatever is left over we shall contribute to the poor."

The committee on licenses of the city council called on Corporation Counsel Green September 20th to recommend that he draw an ordinance for the Chicago Telephone company similar to the one granted the Cushman company, which the latter company accepted. It provides that the telephone fee shall be $75 for three years, or $90 the first year, $85 the second, and $75 the third, in case it was taken by the separate year.

At St. Joseph, Mo., the successful operation of the Sprague system on the road of the Union Railway company has been so marked that the Wyatt Park Railway company of that city has decided to adopt Sprague motors and overhead wiring its cars. The Union Railway company has also contracted for an extension of the Sprague system upon its road.

The New York Board of Electrical Control.

At the meeting of the board September 18th. Expert Wheeler reported that the Board of Public Works had begun removing dead poles and wires as requested, and had already taken down 130 poles and about 100 miles of wire. The electrical companies with a single exception are co-operating in the work. The fire department, the Brush company and the Metropolitan company have been busily engaged in removing straggling wires here and there in order to permit the removal of the poles. A dead line on Forty-first street had been reported to the Western Union Telegraph company, and it was taken down the following day. The Western Union Telegraph company has three separate lines of poles through Forty-sixth street, which formerly belonged to other companies which had come into possession. These will soon be consolidated.

The following additional rules presented by Expert Wheeler were adopted:

ELECTRIC LIGHT CABLES.

No two or more conductors, having a difference of potential exceeding 500 volts, shall be placed in the subway if made in a single cable. This applies to the outgoing and incoming sides of arc light wires.

LOW LAMPS.

All electric lamps must be so placed as to leave a space underneath, of nine feet clear between the lamp and the sidewalk, and eight feet clear between the lamp and the floor, when in-doors.

Dr. Wheeler also presented the following communication to the board:

"*Gentlemen:* To meet the demands of electrical service in various parts of the city, it is absolutely necessary to place more than one class of wire on a single line of poles, before any approach to a safe and workmanlike condition of the wires now above ground can be had. I would therefore recommend, in connection with my letter to the board of July 2nd, relating to rules 2 and 3, that no further permits for erecting poles or stringing wires be granted until the applicants make some satisfactory agreement concerning any use by other parties of the poles, which they propose to erect when necessary, in the opinion of the board."

Dr. Wheeler then read the following report regarding the experiments of Harold P Brown:

"*Gentlemen:* The paper and experiments by Harold P. Brown before your board, while very interesting, do not bear upon the points in which you are directly interested. Mr. Brown may have shown that an alternating current is fatal at a lower pressure than an equally fatal continuous current, but the continuous currents now in use are all run at pressures considerably in excess of that which would be fatal, except the Edison incandescent current, and consequently there would be no justice in prohibiting the introduction of the alternating current on account of danger, or even limiting its pressure with a view to safety, unless the limit of voltage for every kind of circuit is made so low as to prevent the use of all arc lights, which is hardly a step to be considered at present.

"As to the tests made by Mr. Brown to show the voltage required to kill, while they are doubtless correct, and the readings taken are interesting, there were in each case some elements missing which are necessary for perfect reliability, and consequently the tests cannot be taken as absolutely proving the important points. The automatic devices for cutting off the current proposed by Mr. Brown were not exhibited, excepting incidentally."

Commissioner Gibbens stated that something radical must be done regarding the overhead wires before the rules of the board could be enforced requiring every arc lighting company doing business in the city to have a certificate of inspection from the board. The expert did not consider that any of the arc light lines were properly constructed. It was voted that he be instructed to prepare revised rules and regulations so far as they relate to the construction of electric light lines, the report to embrace his views regarding a proper system of construction.

Commissioner Gibbens also introduced a resolution to the effect that, pending the preparation of this report, all permits granted for the erection of lines that had not been acted upon be revoked. He had been appointed, in conjunction with Commissioner Moss, to act as a committee to devise some plan for the mutual occupation of poles, but they could do nothing without the co-operation of the companies. All the poles necessary where the companies have contracts for public lighting have been put up under permits from the board. There was one permit in force, however, granted to the Mt. Morris company to erect poles wherever necessary to reach either public or private lights. That, Mr. Gibbens said, was the permit which he had been trying to reach. Under its provisions the company in question had been allowed to stretch its wires from 125th street to Washington market.

The resolution to revoke all permits was adopted, President Hess voting in the negative.

On motion of Commissioner Gibbens it was voted that the expert be instructed to ascertain the owners of telegraph and telephone wires on Broadway, between Fourteenth and Thirty-fourth streets, and on Sixth avenue, between Eighteenth and Fifty-eighth streets, and make a report to the board as to the practicability of getting these lines down, this season.

Commissioner Gibbens added that the mayor had confessed judgment so far as telegraph and telephone wires are concerned, and he had no doubt he would order their removal if they were not placed underground.

President Hess: "Then you have had an interview with the mayor lately?"

Commissioner Gibbens: "I listened to him for about an hour and a half a few days ago."

President Hess: "That is longer than he would listen to you."

Commissioner Gibbens then stated that some time ago he had been appointed a committee of one to institute criminal proceedings against the United States Illuminating company for violating the rules of the board. He had brought action against the company, and by a decision of Judge Gorman it had been held to await the action of the grand jury. The petition to the attorney general for the annulment of its charter had failed. The only case that holds being in the hands of the district attorney, and the duty of the committee having been performed, he requested that it be discharged with thanks, and it was so ordered.

Commissioner Gibbens reported that the subway built by the Construction company on Park Row was untenable on account of the encroachment of the Steam Heating company. The secretary had reminded the Construction company that it was their duty to render the subway tenable for the electric companies. They must either take action against the Steam Heating company or build a new subway. He understood that the water boils in one of the manholes. The secretary was instructed to ascertain if any progress was being made in the matter.

The prohibition party, through one of its organizers, Jeremiah Griffen, applied for permission to erect a pole for a banner at the corner of Broadway and Thirty-fourth street. Commissioner Moss objected to considering it, as being out of the jurisdiction of the board.

President Hess announced that he was a prohibitionist and should vote for it. He was supported by Commissioner Gibbens and the permit was granted. Politicians may be interested in this action for the reason that this was a strict party vote, Messrs. Hess and Gibbens being republicans and Commissioner Moss a democrat.

Several letters were presented from the Board of Public Works saying that the United States Illuminating company claimed that the wires reported as dead by the board were actually in use.

On motion of Commissioner Gibbens it was voted that they be returned to the department with the statement that the board had been very particular to report only such wires and poles as were found to be dead in the expectation that they would be removed, and that the board is gratified with the expected removal of poles which is now going on, and hopes it will be continued.

A letter was read from Secretary Harding of the Citizens' Committee in Boston, stating that the opening of the streets in that city for the purpose of building conduits was causing great annoyance to the citizens, and inquiring if it had been found necessary to prosecute the work at night in New York. The secretary was instructed to reply that the citizens of New York were so gratified at the prospect of removing the wires from the streets that they were willing to endure the temporary annoyance caused by providing subways for their reception.

In reply to an inquiry made at the last meeting, Engineer Kearney reported that there had been constructed in 1888, the following amounts of single duct: Telephone and telegraph, 523,796 feet; electric light, 34,507 feet; Edison system, 7,748 feet; total, 566,051 feet.

There had also been 146 manholes constructed.

An application was received from W. H. Eckert, general manager of the Metropolitan Telegraph & Telephone company for permission to construct an overhead line from the corner of Park Row and New Chambers street, north to the city line for long distance wires. It was referred to Engineer Kearney for investigation and report.

CORRESPONDENCE.

From Germany.

BREMEN, Sept. 1.—America is far ahead of Europe in the electrical line. This applies at least to the following cities which I have visited: Hamburg, Stettin, Friedrichshagen, Berlin, Pottsdam, Charlottenburg, Cassel, Gilsen, Frankfort-on-the-Main, Wiesbaden, Maintz, Metz, Luxemburg, Coblence, Bonn, Cologne, Oberhausen, Munster and Bremen. The only place where I saw an arc lamp that looked like ours was in Hamburg. The Edison incandescent lamp is used to a considerable extent in Berlin and Hamburg. The lamps most frequently seen are the Brush-Swan and Vitrite. There is a large factory near Berlin where they make the latter kind of lamps by the carload. I have not yet seen a pole for telegraph, telephone, electric light, or fire alarm wires. The wires for telephone, telegraph and signals are strung on the tops of houses. The electric light wires are for the most part underground. In Berlin new cables are being laid to light the principal streets. There are to be four arc lights for each block, suspended on iron posts thirty-five feet high. No conduits are used; the cable is simply laid in the sand, about three feet below the surface. When a street is crossed a hole is bored under the asphalt. The cable that I examined was made like the telephone cables in use in Kansas City, with the exception that the outside was wrapped in cord dipped in a compound like P. & B. paint. Although the sand is always moist the cables stand the exposure well, and there are now in successful use cables laid three years ago.

I have not seen any double carbon lamps. The carbons are not copper coated, but plain black, about seven inches in length. Siemens & Halske make two forms of arc lamps, one of 600 candle power and the other of 1,500 candle power. The former are usually used in small stores. The arc lights require 55 volts and 25 to 30 amperes. The prices for the arc light service are much lower than in the United States. The lamps are all built on the principle utilized in the construction of the Van Depoele lamp. The wiring is poorly done in Hamburg; in Berlin the work is somewhat better. In no place do they conform to rules

such as the board of fire underwriters demand. The hotel in which I am staying in Bremen is the first I have seen completely lighted by electricity. A London firm did the work. Double braided conductors are used, strapped against the wall. This would not be tolerated at home. The system does not work satisfactorily. All the lights are out at 10:30, and after that time gas is burned. I was told that the dynamos would not stand the strain. I saw an accumulator plant of 33 cells in Berlin. It does not give satisfaction, and there is considerable complaint about the cost.

In Hamburg I saw the Bell telephone, with the Blake transmitter. In other places Siemens & Halske telephones were used. They are large clumsy affairs. Magnetos are not employed, but instead a push button and a bell. Several other makes, which look like the Edison, that are manufactured here, are employed.

The telegraph instruments are also made by Siemens & Halske. They are like the Gold & Stock printing telegraph instruments. There is no sound reading. The railway signal service is much better than that of America. At every road which the railroad crosses there is an employe to let down the gates and to give signals.

The hotel annunciators are all of the French pattern. I have yet to see a needle indicator. One annunciator is placed in each hall. A signal at the office shows from which floor a call has been given. The bell boy goes to the floor and has to consult the annunciator before he can ascertain the room. For a fire alarm a large gong is placed in the main hall.

The city fire alarm system is similar to the Gamewell. Taking everything in account, I have seen no great improvements in the electrical line. London, of course, is far ahead of any German city. The people here do not believe much in improvements, or at least do not take much interest in them. They say no system is as cheap as gas, so they do not care to make a change.

O. W. Ditsch.

From St. Louis, Mo.

St. Louis, Mo., Sept. 20.—The exposition opened Wednesday, Sept. 5, with everything in excellent running order. The electrical display is exceptionally fine, consisting of 4,000 Edison lights, 600 Heisler, 400 Westinghouse and 150 arc of the Western Electric system.

The automatic engines are also well represented; Armington & Sims, 2 engines; Buckeye, 1 engine; Phœnix, 1 engine; Russell, 2 engines; Watertown, 1 engine; Westinghouse, 1 "Junior" engine; Vandergriff, 1 engine; Atlas, 1 engine.

Although the Heisler company's downtown station is running to its full capacity, the company is still installing lights in large numbers, as it expects to start two 400-light machines and a new Russell engine in the immediate future.

The Metropolitan Electric company was organized in this city a few days ago. It has purchased the franchises and machines of the Excelsior company and of the Cable Electric company, thus securing two well equipped stations.

The Metropolitan will push both the arc and the Westinghouse incandescent systems.

George J. Percival has resigned his position as superintendent of the Wm. Ellison Machinery company, and will devote himself exclusively to the electrical business.

The Bank of Commerce will install an electric light plant in its building at the corner of Fifth and Olive streets.

The St. Louis Accumulator company has been incorporated under Illinois laws; capital stock, $250,000. It proposes to erect a station in St. Louis in the near future for the purpose of supplying light and power. The company controls Southern Illinois, Missouri, Arkansas and Texas, and is licensed by the Electric Accumulator company of New York.

The St. Louis Bridge & Tunnel company is putting in an underground system of electric wires for the purpose of indicating when its hydraulic switches have been opened or closed properly.

S. P. Baird has hung out his shingle as an electrical engineer at 20 North Commercial street. He reports several large contracts on hand.

Your correspondent had the pleasure this week of seeing a Brush arc lamp burning from an incandescent machine. The machine gave an e. m. f. of 100 volts, which was reduced to 50 volts by simply inserting in one of the wires leading to the lamp two metal plates separated about one-fourth inch and submerged in a pail of water. The light was clear, white and steady. The current taken by the arc lamp represents about 14 incandescent lights.

The St Louis Battery company and the Electric Merchandise company are both doing a splendid business.

The St. Louis Western is repairing a 60-horse power engine, preparatory to enlarging its plant.

The widow of Ole Anderson has sued the St. Louis Thomson-Houston company for $5,000 Anderson fell from the second story of a building at the corner of Sixth street and Franklin avenue It is not known whether he received a shock or not. B.

New York Notes.

New York, Sept. 20.—The report last week that there was a conflict of authority between the government lighthouse board and the trustees of the Brooklyn bridge was denied by the latter on Monday. It is now reported from Washington, however, that Acting Attorney General Maury has instructed United States District Attorney Walker of New York to take the necessary legal steps to compel the trustees to comply with the law relative to the lighting of bridges over navigable rivers, etc. It is stated at the office of the lighthouse board that the bridge authorities will be required to expose the usual red and green signal lights, and to do away with all false lights which interfere in any way with the regulation lights considered essential to the safe navigation of the river. The electric lights now on the bridge will, it is said, interfere with these signal lamps, and will have to be removed or effectually screened.

James E. Munson, an expert stenographer who has been engaged for several years in striving to adapt the typewriter directly to telegraphing, has been devoting his time lately to the perfection of a type-setting machine operated in part by electricity. A public exhibition of it was given this week. The primary objects of the machine are speed and the possibility of correcting and justifying the matter before it goes into the galleys. It is a very complicated affair, and an expert mechanic and electrician who has examined it, says it is too complicated for general use, and that its speed over hand work is not sufficient to warrant its adoption in practice. It is operated by perforated strips of paper, similar in some respects to those used for the Wheatstone automatic telegraph system.

The Julien electric car referred to last week went into regular service on the Fourth avenue line on Monday, and is well patronized. It will soon be followed by others of the same pattern. This line runs directly from the Grand Central depot to the postoffice, and it is expected that the introduction of electricity as a motive power will tend to detract from the immense traffic of the elevated roads from that important station.

Robert A. Ammon is a broker in this city, residing at Tompkinsville, S. I., but famous in 1877 as a leader in the great railroad strike at Pittsburgh. He was locked up all Sunday night in the 126th street station-house on the charge of defrauding a woman out of five $1,000 United States bonds, four of which it was admitted were returned. The warrant had been out some time, Mr. Ammon being absent from the city. He was paroled on Monday in the custody of his counsel. Ammon was a telegrapher in the employ of the Pittsburgh, Fort Wayne & Chicago railroad before the great strike, and was an officer of the organization which included all classes of the railroad men, excepting the engineers.

James M. Seymour of Newark, N. J., one of Edison's right-hand men, has been appointed by Secretary Bayard as one of the two United States commissioners to the World's Exposition at Barcelona, Spain. Mr. Seymour was sent to Europe by Mr. Edison when only 19 years old to establish the Edison telephone system, and was afterward engaged by the Bell International Telephone company to establish its system in Belgium, Holland, Sweden and Russia.

The Order of Railway Telegraphers which has attracted considerable attention at the meetings of some of the railroad officers during the past two years is now making itself felt in various parts of the country by creating a scarcity in available telegraphers at the rates of compensation generally established in that service. This has been brought about by the restrictions against teaching students in railroad offices, which policy has been vigorously enforced by the order. The effect is shown in the radical measures which are being adopted on some lines requiring operators to leave the order, or the service of the company by which they are employed.

Commissioner Hess, the well-known electrician and amateur prohibitionist, expressed the desire some days ago to venture a bet of about $20,000 that Harrison would be elected. He was partially accommodated Wednesday evening by Richard A. Cunningham, who bet $2,000 to $1,600 on Cleveland. It is understood that Commissioner Hess holds quite an interest in the Anchor brewery at Dobbs' Ferry, and it is thought that in view of his recently-avowed prohibition sentiments, he is anxious to diminish his investment in this questionable traffic.

Some of the disgruntled Keely stockholders are very anxious to lodge that alleged inventor in jail at Philadelphia, but are not meeting with success. The case came up before Judges Finletter and Reed in that city on Tuesday. They both agreed that Keely had no intention of obeying the order of the court, but that the court's knowledge of the whole business was very foggy and must be cleared up before a writ would be issued committing him to jail. Lawyer Collier was glad to hear that the judges wanted more light, and invited them up to Keely's shop, but they declined. Lawyer Shapely said they would not miss much, as all they would see was a machine resembling a peanut roaster, and a lot of old bolts. Keely's counsel, referring to his opponents, said, "They are in a conspiracy to wrest from Keely a secret that belongs to him, that is just as much his own as a man's watch is his own." The judge stopped the talk by saying that it was not necessary for the machine to operate, and ordered the experts to meet at Keely's shop and report what they saw. P.

Minneapolis Mention.

Minneapolis, Minn., Sept. 21.—The summer meetings of the Minneapolis Electric club have been indicative of the general quietude of all business The attendance at the meetings has been small, and a slack interest manifested. Dog day heat, attractiveness of Minnesota's near and beautiful summer resorts, and consequent disinclination for mental effort, have conspired to bring this about. Vernon Bell, vice-president of the club, expresses the opinion that with the advent of fall and increased business activity, together with the opening of the new club rooms, interest in the club will be greatly increased. Many electricians and new comers have expressed a wish to enroll their names as members. Mr. Bell states that the club is considering another feature, which, if adopted, will materially extend the membership, and excite new interest in the club. It is proposed to hold every other meeting of the club in St. Paul, and creating thereby another sisterly bond between the two cities. Mr. Bell voices the hope that the St. Paul electrical fraternity, who will be benefited by this move, will take an interest in the matter.

S. S. Leonard reports an active demand for commercial lighting and business unusually good for this season of the year. His company is increasing the service in both arc and incandescent lighting, and adding new and improved machinery to the station. The Minneapolis Industrial exposition lighting is in Mr. Leonard's hands. In this service 210 arc and 900 incandescent lights are used. In addition the Minnesota Brush company has on exhibition 30 and 60-light machines.

Bell & Co. note the approach of an increased activity in their line, with an outlook for a good season's business. They have in progress several large jobs in bell and annunciator work. Bell & Co. have recently secured the exclusive agency for the northwest for the Grimshaw wire, and are now carrying a large stock.

The plant in Donaldson's Glass block has been running some time, and has proved satisfactory to the purchaser. Edison incandescent and American arc lights are used. Sprague motors furnish power for cash system and coffee grinders. Mr. Huey, of the Edison company, is well pleased with the plant throughout, and considers it one of the best in the northwest. B. L. McCabe, electrician in charge of the incandescent work, and Mr. Slichter, who has superintended the arc work, are from New York. The 500-light Edison station of Great Falls, Mont., was started Sept. 1st. Owatonna station was started Aug. 14th.

J. H. Vail of New York, was recently in the city looking after the interests of the proposed Edison lighting station for Minneapolis. H.

From Salt Lake City.

Salt Lake City, Sept. 21.— The Rocky Mountain Bell Telephone Company has almost entirely rebuilt its Helena, Montana, exchange, using cedar poles 50 feet long, and has placed in position one of the Western Electric company's multiple switch boards, with a capacity of 900 subscribers' lines; another board of the same size has been placed in the Butte exchange. Both of these exchanges have grown rapidly in the past two years, the former from fifty subscribers on December 31, 1885, to 250 subscribers at this date; the latter from sixty subscribers on same date to 200 at present.

Telephone connection has been established between Boise City, Idaho and Silver City in the same Territory, a distance of 67 miles; the poles used on this line were shipped from Oregon and are of red cedar; a number ten hard drawn copper wire is used the entire distance. A whisper can be distinctly heard over this wire through the Blake transmitter. A funny episode took place June 24th, the day that line was completed, between a mining superintendent at Silver City and a friend in Boise City. The exchange in the latter city is located in the rear of a drug store, and a minute or two after the conversation had commenced a "milk shake" was started in the front part of the drug store in Boise City. The conversation was interrupted

by the mining superintendent at Silver City, saying to his friend at Boise City "For heaven's sake stop that stamp mill until we get through talking." The distance between the telephone instrument and the "milk shake" was about 150 feet, with a closed door between the store and rear room.

Construction will soon be begun upon a line from Boise City through Idaho City, with the terminal at Quartzburg, a total distance of sixty miles. The route of line will be through a mountainous and heavily timbered country, and the line will be completed by November 1st. A.

Indianapolis Items.

INDIANAPOLIS, September 20.—The McNeal electrical street railway ordinance is taking up a great deal of the time of the city council The aldermen not satisfied with their former action, took it up again last night After three hours' session they finally granted the company right to lay tracks on certain streets in the southern part of the city, electricity to be the motive power. The company can use overhead wires, but the council may compel them to put the wires underground at any time The council may call on the company to light the streets along which its tracks run, and the company must improve the street inside and for two feet on either side of its rails This evening the council met in special session, and the McNeal ordinance as amended by the board of aldermen, came up. In the first place it was objected to on account of allowing overhead wires. Some of the company's friends argued they would use the most approved machinery, and probably the storage battery. The mayor finally took the floor and said in view of the court's action in case of the Dudley company, a few weeks ago, it would be advisable for the council to go slow. A committee was appointed to report on the ordinance next Monday night. It is reported here that the Thomson-Houston company is interested in the new venture.

At the council's meeting last Monday night an ordinance was introduced fixing conditions under which an incandescent electric lighting plant may be operated in this city. Among the stipulations is one that the company or companies must pay 2½ per cent. of their gross revenue to the city after 1891 and 5 per cent. after 1896; the company or companies must not operate arc lights, and must put their wires underground. To-night the ordinance came up and was passed. The ordinance also calls for a bond of $25,000.

The new union station was opened for use Monday night and is one of the best lighted buildings in the country The incandescent lights inside the station proper and arc lights in the baggage rooms, train sheds and approaches show off the buildings to good advantage. It is a piece of work of which the Jenney Electric company may be proud. M.

An Electric Club at Cincinnati.

CINCINNATI, O., September 22.—About twenty-five gentlemen met September 13th to organize an electric club similar to those in Chicago, New York and Boston. A. R. Foote was elected temporary chairman and Thomas Nicholson temporary secretary. About sixty names were presented of those interested in electrical affairs, who had signified their desire to join. A committee was appointed to draft a constitution and by-laws, and nominate officers.

At the meeting September 20th a constitution was adopted and the following officers were elected: President, A R. Foote; vice-presidents, C. E. Jones and William Dillie; secretary, Edgar A Edwards; treasurer, William Jones. The organization was named the Cincinnati Electric Society. D

CINCINNATI, September 8.—The following companies have elect ical exhibits in the Cincinnati exposition: Spangenberg Electric company, Incandescent Electric Light Dynamos, Cincinnati, O., Standard Electric company, Geo. F. Card Electric company, the Queen City Electric company, the C. E. Jones Electric company, Niles Tool Works; Hamilton, O.; Universal Radical Drill company, Cincinnati, the Dodge company, Dodge; Independence wood split pulleys, Mishawaka, Ind.; Joseph Sharp, leather belting; Weber Bros. & Co, Wright's Patent Belt Holder. The dynamos for the exhibition are driven by engines made by Russell, Massillon, O.; Buckeye, Salem; Atlas Engine company, Indianapolis. McD.

Kansas City, Mo.

KANSAS CITY, Mo., September 22.—The Hotel Midland, one of the finest hostelries in this city, has recently been thoroughly equipped with the electric light. In the house there are 1,200 incandescent lamps and nineteen arc lights, the latter being distributed as follows: Six in the dining room, three in the office, two in the bar room, one in the water closet and wash room, one in the east, one in the west, and two in the main corridor, and one over each entrance. The incandescent lights are of the Edison type and the arc of the Thomson-Houston system. Current is supplied by the Edison Electric Light & Power company and by the Kansas City Electric Light & Power company.

The Western Electric company of Chicago have installed a 300 number annunciator and improved guest call and fire alarm. The wiring for the lights was also done by the same firm. The work was performed under the direct supervision of Mr. Glover of Chicago.

The owners of the hotel propose to establish telephone toll stations on each floor with telephone to every six rooms. McD.

St. Louis, Mo.

ST. LOUIS, MO., Sept. 21.—The reconstructed United States Electric Lighting company plant in the Custom house, in St. Louis, will be one of the finest plants of its kind in the west. It will consist of six dynamos each of 350 light capacity, and three dynamos for arc lighting. The power will be furnished by four Porter Allen engines. The plant will also be equipped with current and potential indicators, and have all the modern improvements. The present plant consists of three 250 light dynamos, and three arc dynamos. Mr. Crossmeyer, the able and efficient electrician, has everything in A No. 1 order.

J H. McDonough, formerly electrician for O. J. Lewis & Co., is representing the Waterhouse system in this vicinity.

A sample cell of the Woodward electrical accumulator is on exhibition. Geo. J. Percival, agent, reports prospects good for installing several of these batteries for incandescent lighting. The maximum rate of charge and discharge is very high. B.

From Montgomery, Ala.

MONTGOMERY, Ala., Sept. 18.—President Joseph of the Capital City railway, which has been using the Van Depoele system of electric street road, and which was burnt out about six weeks ago returned from the north a few days since; he received very flattering propositions from the Thomson-Houston company, also from the Sprague Electric company. It is undecided as yet what the company will do.

The Brush Electric Light company has the arc and incandescent system in use here, and is preparing now to add the Westinghouse system, and expects to have it in operation by October.

W. B. Ludwig has accepted a position here with the Western Union Telegraph company. W.

THE ELECTRIC LIGHT.

The Union Stock Yards & Transit company of Chicago recently increased its Excelsior electric light plant.

The University of Wisconsin at Madison, Wis , has increased its Excelsior electric plant to 15 arc lights.

The Thomson Houston company of Chicago has sold a plant of 25 arc lights to the city of Aberdeen, Miss.

The Western Electric company of Chicago has closed a contract for installing a 60-light arc plant for the city of Xenia, O.

W. W. Cummer of Cadillac, Mich., has ordered a 500-light incandescent plant of the Thomson-Houston company, of Chicago.

The Van Depoele company of Chicago will install a 24-arc light plant in the stores of the Tobey Furniture company, Chicago.

A company has been formed at Albany, Ga., to erect an electric light plant.

Ruick & Lampson of La Grange, Ind., have ordered a 300 light incandescent outfit of the Thomson-Houston company, Chicago.

S. & J. C. Atlee of Fort Madison, Ia., have recently increased their electric light plant by purchasing a number of Brush arc lamps.

The new United States steel cruiser Baltimore is lighted throughout by incandescent lights, and is equipped with powerful search lights.

The Oval Wood Dish company of Mancelona, Mich., has purchased a 24-arc light plant of the Thomson-Houston company, Chicago.

The Rome Gas Light company of Rome, Ga., is remodeling its gas works, increasing its capacity, and putting in an electric lighting plant.

In the issue of September 1st, the Westinghouse company was credited with a plant at Joliet, Ill., belonging to the Waterhouse company.

The Tamerack-Osceola Copper Manufacturing company has sent an order for a 15-arc light plant to the Thomson-Houston company, Chicago.

Alexander Kempt, Chicago agent of the Brush Electric company, has recently sold a small arc light plant to the steamer Pauline, Hannibal, Mo.

The Menominee Electric Light company, Menominee, Mich., has recently increased its electric light plant by purchasing a number of Brush 2,000 candle power arc lamps. The Menominee company reports that it has a large and flourishing arc and incandescent electric light central station.

The Western Electric company of Chicago has received an order for 50 double carbon lamps from the Brush Electric company of Chattanooga, Tenn.

The Chicago City Railway company has recently increased the Excelsior electric light plant at the power house, Twentieth and State streets.

The Thomson-Houston company of Chicago has sold an 85-arc light plant to the Electric Light, Power & Manufacturing company of Dallas, Tex.

The Excelsior Electric company, F. W. Horne, Chicago, western agent, has sold a 60-light arc outfit to the Ely-Walker Dry Goods company, St. Louis.

The city of Chicago recently sent an order for five miles of cable to the Western Electric company of Chicago. The cable is for the city electric light service.

The central station of the Haverford, Pa., Electric Light company was struck by lightning September 13th and burned. The loss will be about $15,000.

The Boston Electric Light company has recently ordered from the Brush Electric company, of Cleveland, Ohio, 25 double arc lamps of 2,000 candle power each.

The Consumers' Electric Light company of Chicago has purchased 150 arc lights of the Western Electric company of Chicago. This order is in addition to the 300 lights recently purchased.

The newly organized Metropolitan Electric company of St. Louis has purchased of the Excelsior Electric company F. W. Horne, western agent, Chicago, 60 arc lights, as increase to the present plant.

Electric lights on steamers, to be used mainly in fogs, are advocated in Cleveland, O. An electric light or its reflection can be seen some distance in thick weather when an ordinary ship's lantern is invisible from the decks.

The new central station of the Boston Electric Lighting company is being built. The building will be three stories high and 160 feet long by 50 wide. There will, at first, be fifty-two dynamos set here, with a capacity of 3,000 arc lights. In addition dynamos are to be used to furnish power, and current for incandescent lights.

The electric light wires ignited the lathwork in the ceiling of the upper hall of Union Depot, Chicago, August 29th. The roof was in a blaze when the firemen arrived. The fire was soon extinguished. An hour and a half later it again broke out from some smoldering coals, and a chemical engine was sent to the scene. The damage will not exceed $350.

W. J. Buckley, Chicago manager of the Fort Wayne Jenney Electric company, has secured the contract for the installation of a 500-light alternating plant at Galena, Ill. The Slattery alternating street system is to be introduced. An individual converter will be provided for each 16 c. p. street lamp. There will be seven miles of circuit with a No. 6 wire.

The Pueblo Light, Heat & Power company of Pueblo, Col., has bought the ground for its electric light plant, has ordered the machinery, and expects to have it running within sixty days. It will start with a 1,300 light plant, so arranged that the capacity and number of lights can be increased from time to time as desired, and will operate under the Westinghouse system for incandescent light.

An accidental death from touching an unprotected electric wire occurred recently in Austin, Tex., where a young colored man, who served as porter in a saloon, went to wash some windows and was soon after found dead. It seems that while washing a window through which a wire passed that connected with a fan motor, he touched the wire and its insulation having become destroyed by exposure, the death resulted.

Superintendent Runge of Minneapolis, Minn., has presented his estimates for street lighting for one year from March, 1889, to February, 1890, as follows: 906 Globe gas lights, 720 Wheeler Reflector, 866 Sun Vapor, 6,000 gas and 465 electric lights, including the lights which the city is bound to use, in compensation for the lights voluntarily discontinued by companies in the past few weeks. The entire estimated cost, including $1,000 for incidentals, is $171,000.

One of the Plainfield, N. J., electric light wires which cross a street, became loosened by a falling limb, so that it sagged. The electric company was notified several times of the condition of the wire, but paid no attention to the notification. Mrs. Brooks, while out driving, was thrown from her carriage and very severely injured by the wire catching the top of her carriage. The company was not willing to make any concession, and a suit is being brought against it for $5,000 damages.

In New York city last week Judge O'Brien handed down a decision in favor of the plaintiff in the case of Philip Braender against the Harlem Lighting company. The plaintiff alleged that the machinery in the defendant's plant jarred continually his houses on One Hundred and Twenty-second street. The court found that the injury was not of a permanent character, but would be removed by the change in the location of the plant. It was held that the plaintiff had a substantial basis for alleging that machinery created unusual disturbance to tenants. The decision concluded as follows: "The defendant testified to the expenditure of about $200,000 for machinery, etc. It is at present supplying under contract with the city all the electric lights for the streets in Harlem, besides merchants and tradespeople in that district, and the effect of an immediate injunction might prove ruinous to defendant, besides subjecting many persons using the lights and the city to much inconvenience. I am not unmindful, moreover, of the fact that much of the injury complained of, if suffered to be continued for a short time longer, can be compensated for in damages Taking into consideration the additional fact that the injury to defendant by the issuance of an injunction which would compel an immediate suspension of business would

be greater than the benefit accruing to plaintiff, I am of opinion that while plaintiff should have judgment, the defendant should be allowed some time, to be fixed by the decree, to remove its plant before the judgment takes effect."

It is reported in a Boston paper that the Sullivan Harbor Land company contemplates using strong tidal currents which run through a narrow channel for the purpose of generating electricity for illuminating purposes. The plan is to sink two sets of turbine water wheels which will run immense dynamos and produce currents that will be stored up in accumulators. From these can be supplied lights for the streets, hotels and pavilions, and cottages. Sorrento and The Bluffs, at Mt. Desert, may also be supplied.

Residents of Portland, Me., are speculating about certain mysterious bright lights, like big fires, that appear on occasional nights From Portland they appear to be in Gorham or Alfred, from Alfred they seem to be in Scarborough; Scarborough folks have located them in Westbrook, and Westbrook sees them off toward Portland. The most reasonable theory according to the New York *Sun*, to account for them is, that they are a sort of mirage, produced by the reflection of the Portland electric lights. They are always seen on foggy evenings.

Alexander Kempt, Chicago agent of the Brush Electric company, has recently sold two incandescent electric light plants—one to the Mishawaka Woolen Manufacturing company of Mishawaka, Ind., consisting of a 150 light incandescent dynamo with a full complement of lamps, the other a duplicate plant to Studebaker Brothers Manufacturing company of South Bend, Ind. The Studebaker Brothers have a very complete arc and incandescent Brush electric light plant Some of their dynamos have been in operation for seven or eight years and are to-day working as well as at the start.

THE ELECTRIC MOTOR.

A proposition has been submitted to the Paris municipal authorities to run a single-rail overhead road, by electricity, at the time of the exposition in 1889, which is to connect a large number of the boulevards of Paris, and to have connection to the exhibition grounds in the Place du Trocadero.

An electric motor is in successful operation for wood sawing in Lewiston, Me. It is a six horse power, and with a 26-inch saw, which was driven at a velocity of 1,450 revolutions per minute, a cord of slabs was sawed in twenty minutes. The proprietor claims that with a six horse power electric motor he can do more work than with a 10 horse power steam engine.

The East Cleveland Railroad company has just closed a contract with the Sprague Electric company for the construction and equipment of its line, everything to be in operation by Oct. 1. The power house will be erected forthwith, and will be 93x125 feet. Four Edison dynamos of 40,000 watts capacity will be put in to begin with, but the building will be so arranged that without changing its line the motive power can be increased to 1,500 horse power. Sixteen car bodies have been ordered. They will be four-wheel cars with two axles, and each axle, working independently, will have an electric motor of the Sprague company. Each of these motors is 7½ horse power normal, and is guaranteed for 11 horse power on emergency, and can work up to 30 horse power for short distances. The cars will all be equipped with lightning arresters.

The Chicago *Tribune* recently printed these interviews on the subject of the electric motor: "It is the thing," said City Electrician Barrett. "One gets light and power at the same time without the dirt of the steam engine, or the extra expense of keeping an engineer and fireman around. The power is handled easily, and without any switching. It is taking strong hold in the city, simply awaiting the electric privileges from the companies before being generally accepted." "Hitherto this city has had only isolated plants," said F. N. Armour, the manager of the "C. & C." company; "that explains why there are not more electric motors in the business houses, shops and factories. It is a saving of money; is not one half the bother that a steam engine is, nor dirty or noisy, and it is perfectly reliable." "You can see for yourself, too," said C. M. Barclay, "that much of the smoke nuisance would be done away with. All these small steam engines consume coal. Take them in the aggregate, and you get a substantial looking cloud of 'nuisance.'"

The Sprague Electric Railway & Motor company has contracted for the electrical equipment of the People's Electric Street Railway at Scranton, Pa. There will be twenty cars and the system of wiring will be overhead with the small No. 6 bronze wire as a working conductor. The People's line is the longest in the city of Scranton and operates over twelve miles of track with more than one hundred horses. The power station for operating this road will be one of the finest in the country with steam and electrical capacity to almost an unlimited amount An item of great importance is the cheapness of the fuel which will be used for generating the power. This fuel, is culm, or anthracite waste which can be obtained in Scranton at the rate of 10 cents a ton and which has been proved to have at least 75 per cent. the steam-producing capacity of the best anthracite coal. With this cheap fuel, electric power can be produced at a very low expense and it is the intention of the company to furnish power at a very low price by means of electric motors as well as to furnish enough for their own cars.

The Sprague road at Minneapolis, Minn., will be in running order by January 1, 1889, and the Sprague company guarantees its successful operation The cars will be run from Bridge square to the end of the line, a distance of 14,000 feet, or over two and one-half miles. The power will be furnished by the Edison Electric Light & Power company, whose plant is now building in the rear of the Lumber exchange. Mr. Lowry, the president of the company, has a provisional contract with this company to furnish power for the entire system The construction of the plant is rapidly going forward and it will be running by December 15th. It will be one of the most important industries in Minneapolis, and will furnish power not only for the street railway system but for a great part of the manufacturing establishments in the city, as it is more economical than steam power. The building will be eleven stories high, and fireproof. Its construction is such that the power capacity can be increased, the idea being that the company will be able to furnish all the power used in the city if necessary. The capital stock is $500,000, and some of the wealthiest men in the city, including T. B. Walker, C. H. Chadbourn, S. G. Cook, H. C. A Keley and C. H. Maxey are interested in the enterprise. One of the seeming difficulties which beset the adoption of the motor in Minneapolis is the snow. This, however, amounts to nothing. The Sprague company has what it terms its working car which is equipped with two fifteen horse power motors and carries snow plow, ice cutter and sand and salt arrangements, keeping the track clear in winter.

It was reported to us, says the Dayton, O., *Herald*, that a Third street car-horse said to an Oakwood line mule: "What do you think about these White Line electric cars dashing along without any of our kith or kin having anything to do with their locomotion?" "To tell you the truth," replied the mule, "I like them. What a burden they take from the shoulders of the horse and mule generations to come after us. They will rise up and call us blessed, because we, in our generation, witnessed the emancipation of our races from the hard, stony street slavery and extreme hot and cold weather exposure of the 'hoss-car' age." "Do you feel any fear in passing an electric car?" asked the horse. "No, I do not, although I expected to be dreadfully shocked at first." "How do you feel when you pass by one of the cars?" "Well, I must confess that I was somewhat afraid at first," replied the mule, "but the *Herald* has said so many good things about the cars that I concluded there wasn't any danger of one of them hurting me, and so I just

'Hold my head up high,
And go confidently by.'

"Ah! you are quite a poet," said the mule, with a smile. "Well, we will in the years to come have an opportunity of enjoying more poetry than we have in the past," replied the horse, "when all street cars are run by electricity." "That is so," said the mule, and here's hoping that the officers of the White Line will make electricity so popular that everything on wheels in the city will be run by it, and we will have nothing to do but eat and sleep. But I'm off. So long." "So long," replied the horse, as he started for the Soldiers' Home.

THE TELEPHONE.

The Bell Telephone company of Buffalo will soon commence to lay its wires in Rochester, N. Y., under ground.

The Telephone Mining & Reduction company of San Francisco has been incorporated. The following are directors: John Watson, Henry R. Ewalt, J. B. McChesney, J. M. Miner and James W. Nelson. The company's operations will be in the Tombstone district of Arizona. The amount of capital stock is $1,000,000.

THE TELEGRAPH.

The New York *Tribune* states that the Western Union earned $300,000 more in August than in the same month last year.

Judge Barrett, in Supreme court, New York, after listening to the argument upon the motion to continue the injunction granted to the Kiernan News company restraining the Stock Quotation Telegraph company from taking its news from the tickers of the former company, refused to grant the motion, because the affidavits were so conflicting. The continuance of the injunction would be a judgment in favor of the news company He thought the questions of law and fact should be tried.

In the United States senate August 29th Mr. Blair offered a resolution, which was referred to the contingent expenses committee, instructing the committee on Inter-State commerce to examine fully into the system of mechanical telegraph, now on exhibition at the capitol, and to secure the aid of competent and disinterested experts. The system was recently described in the WESTERN ELECTRICIAN. He explained that the object of his resolution was to have this system of telegraphy examined, and if found to be as represented, to secure it for the benefit of the people. He had been told by D. H. Craig, the owner of the patents, that 2,000 words could be sent on the wires at the cost of a single letter postage. Mr. Blair spoke of the Western Union Telegraph company as a gigantic monopoly that owned every telegraphic invention and every telegraph line and wire in the country, and thus had a practical mortgage over the telegraphic business of the country, against which there was no redress unless congress saw fit to interfere and buy out that company at an extravagant valuation. Here was an opportunity to introduce a system which would supplant the other at comparatively slight expense. He did not know whether there was anything in it, but he wanted to have the matter considered.

The work of putting in the conduits for underground fire and police telegraph wires has been about completed on the east side, says a Milwaukee correspondent. Should the experiment prove a success on the east side appropriations will be made by the council for putting the west side wires out of sight. When this is done the time will not be far distant when all wires will have to follow suit. The conduits are four-inch iron pipes, placed about two feet below the surface of the street near the gutters. This prevents tearing up the middle of the street in case it is necessary to get at the conduits for any cause. At the end of each block the conduits run into manholes. Supt. Glassner of the fire department has taken a new method of making connections. Heretofore considerable difficulty has been found in making connections in the manhole. In the present system Supt. Glassner carries his wires out through an opening in the manhole nearest the sidewalk and makes all the connections outside It is expected this will do away with all the trouble that has been experienced in the past. The cable now being prepared contains twenty wires. The work of laying it will be begun shortly. The police cable will be the same size. The conduits now laid are large enough to accommodate several cables of that size if necessary.

A dispatch from La Porte, Ind., says: "The Western Union telegraph operators at the Lake Shore depot in this city and those along the line of that road have received orders from headquarters to sever their connection with the Telegraphers' Union at once or vacate their places. It is said that the company has secured men to fill all vacancies likely to occur." Inquiries in Chicago among Lake Shore officials elicited the following: "There are very few members of the Order of Railway Telegraphers in the employ of this road. There are but six or eight on this division, which reaches from Chicago to Elkhart and includes La Porte. Such a rumor has been afloat here, and may be true. The object of such a movement would be, of course, to prevent the further organization of the men, to kill the union among employes of this road in its infancy."

Personal Paragraphs.

H. Franklin Watts of Sandusky, O., was in Chicago a few days last week.

Harvey L. Lufkin, of the C. & C. Motor company, New York, was in Chicago last week.

J. Elliott Smith, of the electrical staff of the New York fire department, was a recent visitor to Chicago.

Irvin Chase has been elected secretary of the United States Electric Fire Alarm company of Evart, Mich., in place of B. G. Colton, resigned.

A. R. Foote, secretary of the Queen City Electric company of Cincinnati, was in Chicago last week in attendance at the reunion of the Army of the Cumberland.

Expert Steringer, of the Edison company, of New York, was a recent visitor to Chicago, and spent some time in a careful inspection of the new Chicago Edison station.

F. W. Mackey, manager of the Missouri & Kansas Telephone company, of Emporia, Kan., visited Chicago last week on his return from the G. A R. encampment at Columbus.

George Cutter, of the Chicago office of the Thomson-Houston company, is receiving congratulations on the fact that he has deserted the ranks of the bachelors. The good wishes he receives are as well bestowed as they are hearty.

Business Mention.

The Pennock Battery Electric Light & Improvement company exhibit their light run by a primary battery in the Royal Insurance building, Chicago.

The Western Electric company of Chicago has just issued a new catalogue of electric bells, push buttons, and gas lighting apparatus. The catalogue will be sent to all persons in the business who apply for it.

Edward W. Tisdall, representing the Brush Electric company in Philadelphia, has recently sold a complete electric light plant consisting of 225 incandescent lights to the Ellis & Lessig Steel & Iron company, Pottstown, Pa.

The Chicago headquarters of the Campbell Electric Supply company are at 117 Dearborn street. W. M. Talcott is the agent. He will have large orders for the Vulcan insulated wire which has such a splendid reputation in the west.

J. E. Ridall, representing the Brush Electric company in Pittsburgh, has recently sold an electric light plant to the Pittsburgh Traction company, consisting of a 30-light 2,000 candle power arc dynamo with a full complement of lamps.

J. E. Land has taken the agency for the Western Electric company at Dallas, Tex. His territory will include Texas, Arkansas and Louisiana. Mr. Land is also agent for the Fisher Motor company and the Mather Electric company.

W. J. Buckley, manager of the Chicago office of the Fort Wayne Jenney Electric Light company, has just moved into new offices in the Adams Express building on Dearborn street. The new quarters are handsomely fitted up and are brilliantly lighted by electric light.

The Electrical Supply company of 171 Randolph street, Chicago, has taken the agency for Wright's armature protector. The invention has commended itself to electric light companies, and a considerable number of protectors has already been sold—in fact, no less than twenty within a month.

Alexander Kempt, the representative of the Brush Electric company in Chicago, has sold during the past season a large number of electric light plants for steamboats on the Mississippi and its tributaries. Some of the Brush plants used on the Mississippi River steamboats have been in use for a number of years.

Chas. A. Schieren & Co., of New York, report recent sales of their leather link belting to the following for use on dynamos: Lockport Gas Light company, Lockport, N. Y.; White Plains Electric Light company, White Plains, N. Y.; T. Hawley & Co., Bridgeport, Conn.; city of Ypsilanti, Mich.; H. L. Childs & Co., Pittsburgh, Pa.

William Hubbard & Co., of Elgin, had a showy wagon on exhibition in Chicago last week. Its sides are covered with gilt lettering setting forth the kind of goods handled by the firm. On the back of the curtain is an acrostic. The wagon contains electric bells of all kinds, Elgin telephones and electric apparatus of all sorts. The box is carpeted with electric matting. It is the purpose of the firm to send the wagon through the country and to furnish elec-

tric apparatus to all who need it. Interested persons can be shown the working of the apparatus by inspecting the permanent exhibition in the wagon.

The Nutting Electric Manufacturing company of Chicago has been organized; capital stock, $100,000; for the manufacture of electric apparatus; incorporators, Samuel E. Nutting, W. H. Foulke, and J. W. Hedfenburg.

A very interesting catalogue has just been issued by the Woodhouse & Rawson Electric Supply Co., of Great Britain, limited, of 11 Queen Victoria street, London, Eng. It is devoted to switches, cut-outs, wall sockets and switch boards, and in each class a wide range of instruments is shown. The illustrations bear evidence to the well recognized fact that excellence of goods has been the chief aim in their construction.

At the Centennial exposition, Cincinnati, 240 Waterhouse arc lights are lighting the park buildings and surroundings, and the government exhibit. The effect is not only beautiful outside but where the finest and most perfect lighting is required inside, the Waterhouse gives entire satisfaction, being free from hissing and pumping. The company has an office at Cincinnati at 56 Longworth street, W. N. Gray agent, and also at 154 La Salle street, Chicago, C. F. Dunderdale agent

The Sprague Electric Railway & Motor company since the last issue of this paper has closed the twenty-sixth contract for equipment of railroads on the Sprague system. When it is remembered that this is simply the record of the last six months, and that on February 1st the Sprague company had not a single road in operation, it is indeed a wonderful showing. It speaks very directly for the care with which each electrical equipment is prepared, and for the success which has attended each installation.

The committee appointed by the city council of Akron, O., to investigate the subject of electrical railway propulsion has advised in favor of the Sprague system. They visited every successful electrical railway in the country, and the operation of each was inspected. In the report the committee stated that they were fully satisfied from their investigations that the Sprague system was superior to all others, and consequently the contract for equipping the road in that city has been given to the Sprague company. The equipment will consist of twelve cars.

The Jewell Belting company, of Hartford, Conn., have just completed a belt of such size that it deserves especial mention. It is five feet wide and 140 feet long, of two thicknesses of leather, and weighs over 1,600 pounds. It is the widest belt ever made by that concern, though not the longest or heaviest. It is for use in a rolling mill, where it has been found, after careful test, a leather belt is a safer and more economical means of carrying power than the direct action of cogs. In the latter case there can be no "give," while the belt is able to meet the sudden shocks upon it and vibrate a little and yet fully transmit the power. In such wire mills as have used belts they have done their work well. One made by the Jewell company, for a position where the desired width could not be utilized, was of four thicknesses of leather and heavier than this new and broader one. The new belt, with its fine work, has been on exhibition for a day or two as a choice specimen of belt-making.

The National Carbon company of Cleveland, O., in an address to its patrons, in its recent Directory of Electric Arc Lighting Plants in North America, says: "Electric arc lighting has become one of the most important and rapidly increasing industries of this continent. Its growth has been simply phenomenal, and a casual perusal of this Directory of Arc Lighting Plants will demonstrate the truth of this assertion. We believe that it will no longer be doubted that one of the most important factors toward furnishing a good and satisfactory electric arc light is the carbon, for no matter how perfect the dynamos and lamps may be, unless a good carbon, capable of producing a brilliant and luminous light is used, the entire plant will be unsatisfactory. The carbon point has now become a staple commodity, and its users now insist on just as much intelligence and skill in its manufacture as in the manufacture of dynamos, lamps, etc. In addition to the long experience of Mr. Lawrence, the president of our company, in manufacturing, introducing and installing the first Brush arc lighting companies in the country, for which he at the same time manufactured the carbons and other electrical supplies, he has for nearly three years last past been connected with this company and devoted his entire time to all the details of the manufacture of carbon points and plates, and we now claim to have the best equipped factory for this purpose in the country. Recognizing the full force of the demand for a good carbon, it has been the aim of the National Carbon company to improve the burning quality of its carbons for steadiness, brilliancy and life. We have not, however, overlooked the fact that heretofore the brilliant and luminous qualities of the light have been somewhat at the expense of the length of life of the carbon, but in our late experiments for a satisfactory carbon for the long winter nights, we think we now have one that will combine these three qualities to a greater extent than ever before. While we do not claim to be making a perfect carbon, we believe we have gone further in this direction than any other company, and of the enormous quantities of carbons furnished by us since the 1st of September, 1887, we have scarcely had a word of complaint. Our capacity has been doubled within the last year, and we have put in new automatic machinery wherever possible, which, together with the steady and regular heat supplied to our retorts, moulders' furnaces, and drying rooms, by the use of crude oil together with the use of artificial gas manufactured from crude oil in our Siemens Martin furnaces for the thorough baking of our carbons in the furnaces, renders it possible to produce uniform and regular goods, so that if our patrons once get a satisfactory carbon, they can depend upon them hereafter. In addition to the new machinery used in the milling and mixing department, by which the different ingredients become thoroughly amalgamated, we have doubled the capacity of our plating department, and added new gas furnaces to our furnace room, thereby making it the largest in the country.

"We are at the present time engaged in manufacturing moulded, forced and corded carbon points and carbon plates, of different sizes, suitable to all the systems of electric arc lighting now in use in this country. Our moulded carbons 7-16ths, ½, 9-16ths and ⅝ inch in diameter by 12 inches long, copper plated or plain, are adapted to the Brush, Thomson-Houston, American, Ball, Schuyler and other high tension systems of electric arc lighting. Our forced carbons of all diameters and lengths from ⅛ inch up to 2¼ inches, which can be cut to any length desired, are especially adapted to the United States, Western Electric, Sperry, Fort Wayne and Indianapolis Jenney and other low tension systems of electric arc lighting. In addition to the carbons made for regular electric lighting, we are large manufacturers of carbons for experimental purposes, and desire to call special attention to those we make for the Cowles Electric Smelting and Aluminum company of Lockport, N. Y., for conveying the enormous current of electricity necessary for producing the heat required to melt the aluminum in the retorts. The carbons that we are now furnishing them are 2¼ by 50 inches in length, and are bound together in bundles of seven each. We have also made them carbons six inches in diameter for the same purpose. For experimental purposes, as well as for lighting the Statue of Liberty on Bedloe's Island, New York harbor, we are now furnishing the United States government special cored carbons, with or without filling, from 7-16ths to ⅝ in. diameter, as desired. Since the large additions to our works our output has been nearly doubled, and we now have a capacity of nearly four million carbons per month. From the foregoing we trust it will be seen that we are prepared to manufacture in large quantities almost anything in the way of carbon points and plates, and as we are thorough believers in the policy of depending upon the quality of the goods manufactured to produce the demand and sale for them, we will ever be solicitous as to the reputation of our goods for quality of the highest order."

Electrical Patents.

Issued September 18, 1888.

389,601. Mechanical Telephone System. Abner M. Rosebrugh, Toronto, Ontario, Canada.

389,626. Electric Time Recorder. Aloys Wirsching, Brooklyn, N. Y.

389,638. Electrical Distribution by Secondary Batteries. Thomas P. Conant, New York, N. Y.

The fourth claim is given: "4. The combination of a circuit containing a secondary battery, a circuit containing a generator of electricity, a circuit containing a series of translating devices, as lamps, a pair of fixed contact points for each circuit, a switch or circuit changer having three pairs of contacts, an artificial resistance permanently connected to one pair of said contacts, and means for imparting a progressive movement to said switch through five successive steps, whereby the dynamo and the battery and lamps are successively connected and disconnected."

389,640. Rheotome Mechanism for Medical Batteries. Harry B. Cox, Cincinnati, Ohio.

389,658. Armature Winding for Dynamo Electric Machines. Walter H. Knight, New York, N. Y.

The invention consists in making up the winding into a mat, which may be made by machinery, and then applying the same to the ordinary cylindrical core of magnetic material.

389,676. Cell for Electric Batteries. Sylvanus L. Trippe, St. Louis, Mo.

Claims 1 and 7 are given: "1. As a new article of manufacture, a vessel for an electric battery, having a corrugated bottom and a rest for a lid within its upper part.

"7. As a new article of manufacture, a cell comprising a vessel having a corrugated bottom and a recessed top, a frame and electrodes supported thereby, and a perforated lid."

389,678. Fire Alarm System. Thomas G. Turner, New York, N. Y.

The first claim reads: "1. A fire alarm system composed of an electric circuit, in which is located an electric generator, an electric signaling device, a signal box or boxes, and a fire extinguishing apparatus suspended from the mechanism of the signal box, whereby the weight of the apparatus places the mechanism of the signal box in position for automatic action upon its removal."

389,692. System of Electrical Gas Lighting and Extinguishing. Harry T. Downs, Saratoga Springs, N. Y.

The last claim is given: "5. In an electric gas lighting and extinguishing system, the combination of two lines from a station battery and a single return thereto, with two or more electro automatic burners and corresponding electro magnetic circuit shifters adapted to close said lines in succession to the return in multiple arc."

389,729. Electrical Heating Apparatus. John Wiest, York, Pa.

The invention embodies a metallic heat radiator separated from the resisting material by a heat conducting and electric insulating substance, such as a silicate of an alkali or compound containing the same.

389,752. Conductor for Dynamo Electric Machines. Edward F. H. H. Lauckert, Charlton, County of Kent, England.

Instead of employing a solid bar conductor, the inventor twists together a number of wires to form a strand, which strand is then subjected to powerful compression, so as to press the wires closely together and to cause the strand to assume an oblong or approximately rectangular sectional form similar to the well known solid bar conductor. The claim is as follows:

"A conductor consisting of a twisted strand of wire compressed so as to assume an oblong or approximately rectangular transverse section."

389,758. Ground Detector for Electric Light Circuits. Albert W. Morrell, Indianapolis, Ind.

The first of the two claims follow: "1. The combination, in a single structure, of two carbons united at one end and there connected to a wire leading to the ground, and the other ends connected to the line wires, respectively, the device thus forming a ground detector."

389,764. Electro Therapeutic Cap. Nathaniel P. Rutter, Waltham, Mass.

389,779. Direct Welding Dynamo Electric Machine. Elihu Thomson, Lynn, Mass.

The first and eighth claims follow: "1. In an apparatus for electric welding, forging or other metal working operations requiring currents of large volume, a dynamo generator having current collecting brushes attached to the conducting clamps or electrodes which hold the work.

"8. The combination, with the clamps or electrodes for holding the work, of the collecting brush hinged or pivoted to the body of said clamps."

389,781. Process of Electrolizing Sewage and Sea Water. William Webster, jr., Lee Park, Lee, County of Kent, Eng.

The two claims are given: "1. The method herein described of decomposing sewage and other liquid by electrolysis to produce disinfecting and other products, which consists in subjecting two bodies of one and the same liquid respectively to the electrolytic action of positive and negative electrodes, repeatedly renewing one of the liquid bodies, and retaining and continuing the electrolytic action on the other liquid body.

"2. The method herein described of decomposing sea water by electrolysis to produce chlorine, which consists in subjecting bodies of one and the same sea water respectively to the electrolytic action of positive and negative electrodes, repeatedly renewing a portion of the water and retaining and continuing the electrolytic action on the other portion of the sea-water."

389,795. Means for Distributing Electric Energy. Sebastian Z. de Ferranti, London, England.

The second and third claims follow: "2. A converter consisting of a core in the form of a loop or ring made up of a bundle of strips or ribbons of iron insulated from each other, but each forming a closed magnetic circuit, superposed primary and secondary windings, and an independent ring or layer of iron arranged outside the windings.

"3. A converter consisting of a core of iron having its ends united to form a closed magnetic circuit, superposed primary and secondary windings, and an independent ring or layer of iron arranged outside the windings."

389,796. Dental Engine. Constant Doriot, Philadelphia, Pa.

389,799. Automatic Circuit Maker and Breaker. Willard W. Estabrook, Boston, Mass.

389,812. Dynamo Electric Machine. Thomas H. Hicks, Detroit, Mich.

The invention consists in arranging the circuits of the machine so that the windings may be readily coupled in multiple arc or series, as desired, and in providing a double set of brushes, one set being adjustable by hand, so that the current developed may be still further varied by cutting out coils of the armature or field magnet.

389,822. Electric Railway System. John D. Nicholson and William J. McElroy, Pittsburg, Pa., and Thomas J. McTighe, New York, N. Y.

389,838. Means for Distributing Electric Energy. Sebastian Z. de Ferranti, London, England.

The invention relates especially to systems in which dynamo electric machines generating alternating currents of high intensity are employed, and such currents converted into currents of lower intensity at or near the places where the lights are to be exhibited or the energy utilized. The first claim is given:

"1. An electrical converter consisting of strips, ribbons, or layers of iron placed one over the other and carrying a primary and secondary winding, and having their ends doubled back on either side over the exterior of the winding, such strips or layers being insulated from one another and the ends of each strip or layer brought together in electrical contact, so as to form a series of loops or bands insulated from one another, but each forming in itself an independent closed magnetic circuit."

389,839. Telegraphic Call for Messengers, etc. Benjamin Dubinski, St. Louis, Mo.

This is an electro magnetic device by which, by the mere turning of a crank, a certain number is indicated by a relay magnet at a distance—say from a private office to a messenger office—and by turning a crank at the messenger office acknowledgment of reception of the call is made to the private office and a bell sounded indicating that such acknowledgment has been sent.

389,853. Safety Apparatus for Elevators. Charles E Ongley, New York, N. Y.

The claim is as follows: "The combination, with an electric circuit, including an electro motor, by which the elevator starting and stopping mechanism is operated, of a circuit closer and breaker located in said circuit and operated by the door of the elevator shaft to break the circuit by the opening of the door."

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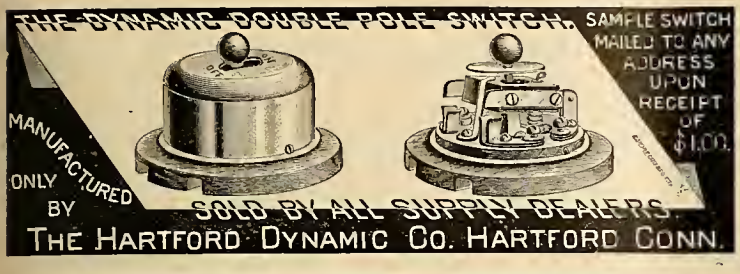

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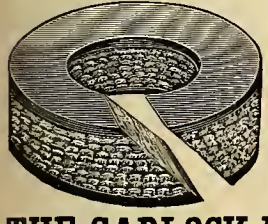

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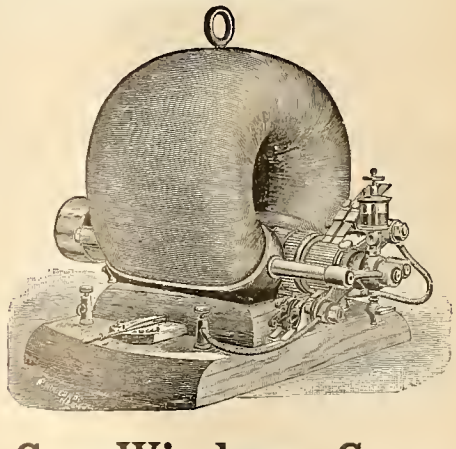

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Each bidder is required to file with his bid a detailed statement of the number and location of the plants then in operation, of the particular system which he proposes to establish in Natchez if successful in bidding, and to specify as to each plant so in operation whether it is the one originally established in such locality or has been substituted for some other previously in use, and, if a substitute, then for what system.

The successful bidder will be required to enter into good and sufficient bond, of such penalty as the Mayor and Aldermen shall hereafter fix, conditioned that he will erect and have ready for use the electric plant, and begin the lighting of the city therewith, on the dates hereinbefore stated.

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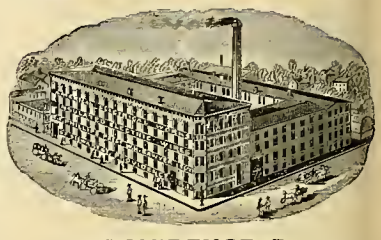

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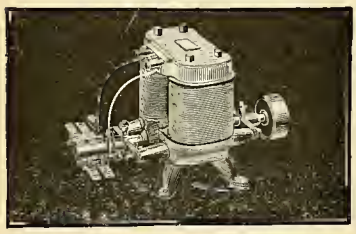

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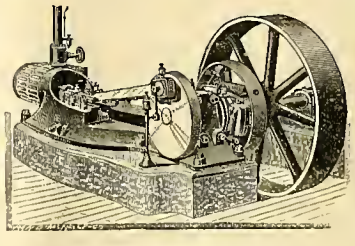

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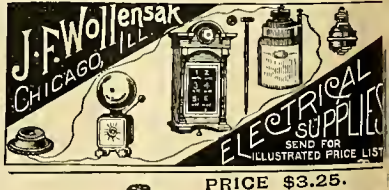

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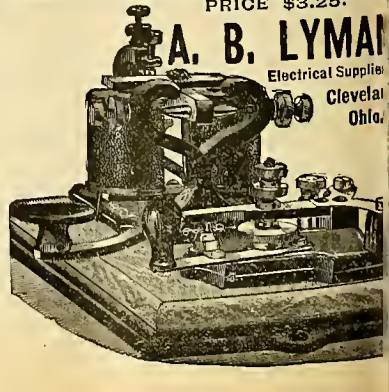

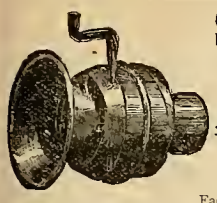

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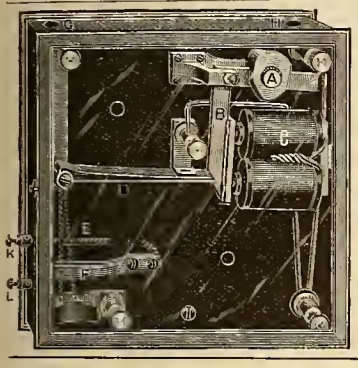

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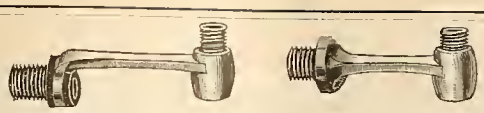

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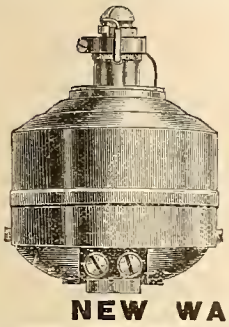

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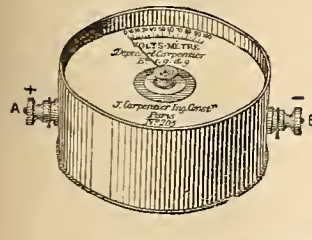

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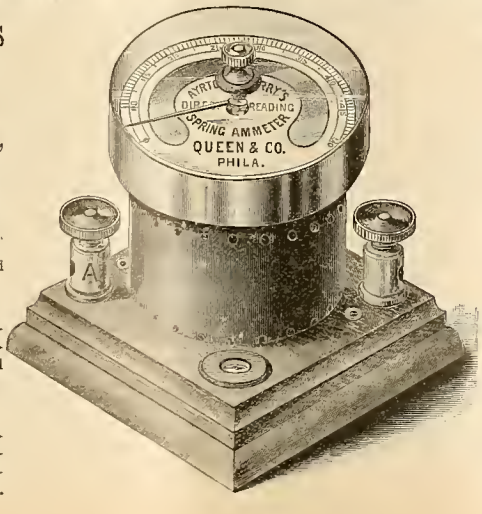

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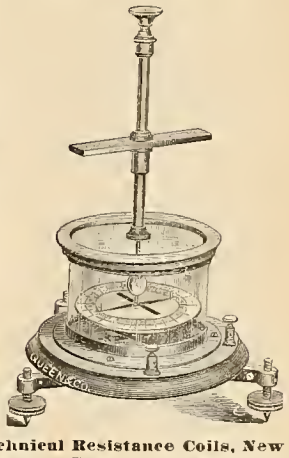

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TABLE OF CONTENTS.

	PAGE.
ELEMENTARY DATA—	
The Electric Current, Chapter I	1, 2
Ohm's Law, Chapter II	2
Work, Chapter III	2
Conductors and Insulators, Chapter IV	2
Direction of the Current, Chapter V	3, 4
Detector Galvanometer and Magneto Bell, Chapter VI	5, 6, 7
ARRANGEMENT OF POWER—	
The Dynamo Room, Chapter VII	8
Motive Power, Chapter VIII	8
Shafting and Pulleys, Chapter IX	9
Foundations for Dynamos, Chapter X	9, 10
Belts, Chapter XI	10
DYNAMO ELECTRIC MACHINES—	
Description of the Dynamo, Chapter XII	11
The Continuous Current Dynamo, Chapter XIII	11, 12, 13, 14
The Series Dynamo	11, 12
The Shunt or Derived Circuit Dynamo	12, 13
The Compound Dynamo	13, 14
The Alternating Current Dynamo, Chapter XIV	14, 15
Preparation of a New Dynamo for Operation, Chapter XV	15, 16
Starting a New Dynamo, Chapter XVI	16
Keeping a Dynamo in Good Order, Chapter XVII	12
Brushes, Chapter XVIII	17, 18, 90
The Commutator, Chapter XIX	19, 17
Repairs, Chapter XX	20, 21
To the Armature	20, 21
To the Field Magnets	21
Testing the Wire Coils of a Dynamo for Contact Against Iron, Chapter XXI	21, 22, 23, 24
DISEASES OF DYNAMOS—	
Non-generation of Current by the Dynamo, Chapter XXII	25, 26
Excessive Sparking of Commutator and Brushes, Chapter XXIII	26, 27
LAMPS—	
Arc Lamps, Chapter XXIV	28, 29, 30, 31
Suspension of Arc Lamps, Chapter XXV	31
Trimming and Cleaning Arc Lamps, Chapter XXVI	32
Incandescent or Glow Lamps, Chapter XXVII	32 33
Multiple Arc System, Chapter XXVIII	33
Multiple Series System, Chapter XXIX	33, 34, 35
Series Multiple System, Chapter XXX	36
Arc and Incandescent Lamps on the Same Circuit, Chapter XXXI	36, 37 38
The Alternating System, Chapter XXXII	38
INSTRUMENTS—	
Current Indicator or Ampere Meter, Chapter XXXIII	39
Pressure or Potential Indicator, or Voltmeter, Chapter XXXIV	39, 40
Current Regulator, Chapter XXXV	40, 41
Switches, Chapter XXXVI	41, 42
Safety Devices, Chapter XXXVII	42, 43
Lightning Arresters, Chapter XXXVIII	43, 44
Ground Detector, Chapter XXXIX	45, 46
Switch-Board, Chapter XL	46, 47
CIRCUITS OR LEADS—	
Outdoor Leads for Arc Lighting, Chapter XLI	48, 49, 50, 51, 52, 53
Outdoor Leads for Incandescent Lighting, Chapter XLII	53, 54
Arc Circuits Inside of Houses, Chapter XLIII	54
Incandescent Circuits Inside of Houses, Chapter XLIV	55, 56, 57
Size of Wires for Incandescent Lamp Installations, Chapter XLV	57, 58, 70
Testing, Chapter XLVI	58
ACCUMULATORS—	
Accumulators, Chapter XLVII	59
SAFETY REGULATIONS—	
Rules of the Boston Underwriters' Union	60, 61, 62, 63, 64, 65, 66
English Regulations	66, 67, 68
Abstract of the Chicago Electric Light Laws	68, 69
Table of Electric Light Conductors	70
Lamp Lighting Schedule—Moonlight System	71–82
Construction Tools	83–89

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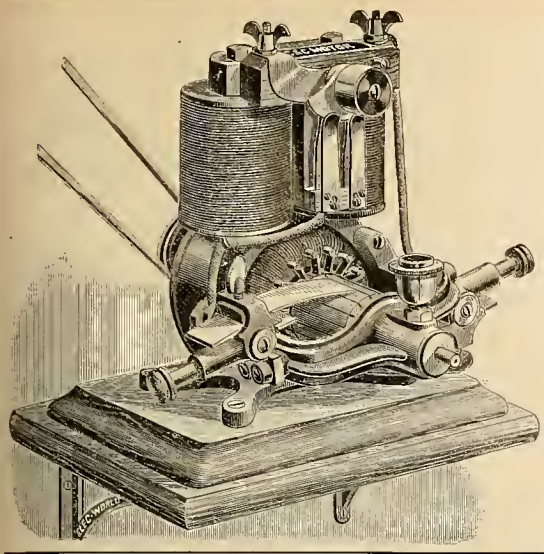

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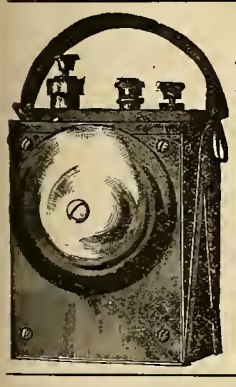

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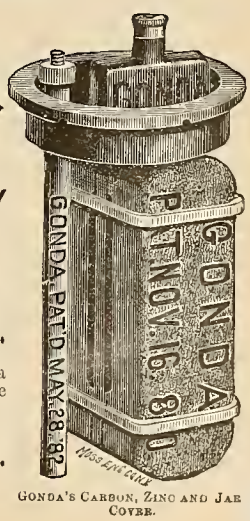

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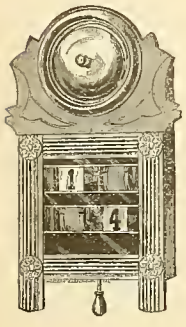

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O. & C. B. Ry. & B. Co., Council Bluffs, Ia.	150	"	Cp.
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" " " " (4th "), " "	150	"	Cp.
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" " " " (10th "), " "	150	"	St.
St. L. & San Franc. Ry. Co., Springfield, Mo.	125	"	Cp.
Cheney Bros , S. Manchester, Conn.	125	"	St.
" " (2d order). " "	125	"	St.
Pittsburgh Refining Co., Pittsburgh Pa.	125	"	St.
O. & C. B. Ry. & B. Co. (2d order), Council Bluffs, Ia.	100	"	Cp.
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Gd. Trunk Ry. Co. (6th order), Montreal, Can.	75	"	St.
" " " (7th "), " "	75	"	St.
Bryden Horse Shoe Co., Catasaqua, Pa.	75	"	St.
Wyatt Park Ry. Co., St. Joseph, Mo.	75	"	St.
" " " (2d order), " "	75	"	St.
Baldwin Loco. Works, (9th order), Philadelphia, Pa.	65	"	Cp.
Quaker City Dye Works, Philadelphia, Pa.	60	"	St.
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Dealer, San Francisco, Cal.	50	"	Jr
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R. Mackintosh, Lundy, Utah.	25	"	St.
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American Glucose Co., Peoria, Ill.	10	"	Jr.
" " " (2d ord), Peoria, Ill.	10	"	Jr.
" " " (3d ord.), " "	10	"	Jr.
H McMorran, Port Huron, Mich.	10	"	Jr.
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Chambers. Turner & Layton, Truro, N. S.	5	"	Jr.
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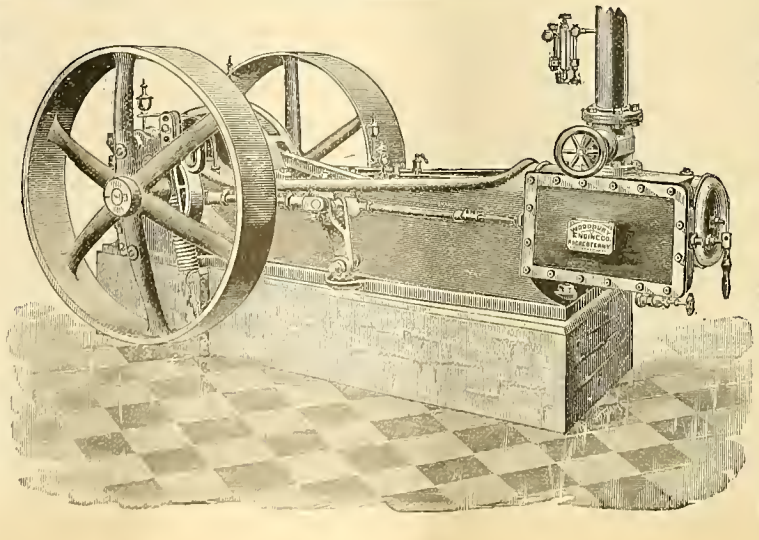

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THE P. & B. ELECTRICAL COMPOUNDS

THESE COMPOUNDS CONTAIN NO COAL TAR, ASPHALT OR OIL, AN IMPORTANT AID IN ALL BRANCHES OF ELECTRICAL WORK.

The good repute which the "P. & B." Compounds enjoy among electrical people who have tested and are using them, induces us to bring the same directly to the attention of *all interested in any branch of electrical work*. The Compound so readily recommends itself that a single trial is all that will be necessary to convince consumers of its merits.

The solvent used in the "P. & B." is very powerful, making the Compound penetrate very thoroughly, hence the "P. & B." Compound will hold on surfaces more tenaciously than anything else will. It is very quick drying and good body coating; is a complete preservative for wood, iron, brick, or fabrics of all descriptions; makes surface thoroughly water-proof, and resists the strongest alkalies and strong acids. Cold does not affect the coating at all, and great heat applied to the material, after it has dried, will only melt it, and *will not burn; fire will not spread on it.*

It possesses high insulating properties. These properties have *been demonstrated* in a great number of directions. We can refer to leading and well-known electricians in this and other cities. It will pay any one interested in electrical work to *get some of this material and test it.*

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The "P. & B." Compound will not rub off when drawn through wood conduits; being a lubricant, it takes less labor to pull through, and the cable is relieved of at least one-third of the strain. No amount of bending will cause the Compound to raise from the lead, and the cable will crack before the Compound breaks. The Compound will not rub off.

USES.

No. 1232. For electrical work this brand should generally be used. The following are a few of the purposes.

For insulating connections, painting moldings and wires when laid in damp places or subjected to acid or alkaline fumes, or under cement; to make cut-out boxes water-proof and practically fire-proof; circuit-boards; lamp-hoods; cross-arms; for water-proofing manholes of underground conduits; as a substitute for shellac in many directions. The "P. & B." is also used largely for painting lead cables for use underground; is in successful use on electric cars, for storage batteries, etc.

No. 1233. This has a heavier body than the No. 1232; is not so penetrating and dries somewhat slower, leaving a heavier body of material deposited on surfaces to which it is applied. We would recommend it for use on manholes of subways, or underground conduits; for making joints in wooden conduits; for the parts of poles which go underground, and other like purposes.

No. 1231. Will dry rapidly, and is very penetrating. Its main use is on webbing and fibrous materials, where it is desired to retain as much of the pliability as possible.

PRICES.

Trade Nos.	In single gallon lots.	In five gallon lots.	In barrel lots.
1232	$2.20 per gal.	$2.05 per gal.	$1.85 per gal.
1233	1.85 per gal.	1.70 per gal.	1.50 per gal.
1231	2.45 per gal.	2.30 per gal.	2.10 per gal.

P. & B. WATERPROOF AND WEATHERPROOF LINE WIRE.

The growing demand for a better insulation than Underwriters for overhead wires, and the great success which attended the use of "P. & B." Compound for insulating purposes, led us to experiment with a view of making use of the "P. & B." Compound for the purpose of insulating wires. The result of our experiment was more than satisfactory, and, after testing our "P. & B." wires ourselves for over a year we placed samples in the hands of some of the leading electricians of the country with the request that they would subject the insulation to thorough test, and report to us the result. In every case the report showed that the insulation came fully up to the opinion we first formed concerning it.

The points of advantage possessed by "P. & B." insulation over other insulations for overhead use, are as follows:

1. "P. & B." is *thoroughly waterproof*, and therefore a safe and satisfactory insulation in wet weather as well as dry. On this account it is suitable for such work as running through foliage.

2. There are no grounds heard of, after wet weather, on lines where only "P. & B" insulation is used. This is an advantage which is not undervalued by Superintendents of Electric Light Plants.

3. "P. & B." insulation retains the remarkable preservative qualities of the "P. & B." Compound—will not crack or become rough by handling, adheres firmly to the wire under all circumstances, is not affected by heat or cold, acids or alkalies, and will present a solid, clean appearance, after years of use, while other makes of insulation would cause a circuit to present an appearance somewhat like a clothes-line—insulation stripped—hanging and worthless.

4. Although "P. & B." insulation is by far the best and most economical for any Electric Light Company to use that values the paying power of its plant, it is sold at a price very little in advance of amount charged for inferior insulations.

"P. & B." insulated wires are also used for house work, for use in mines and other places where ordinary insulations are useless on account of dampness and gases.

Full Particulars and Quotations on application.

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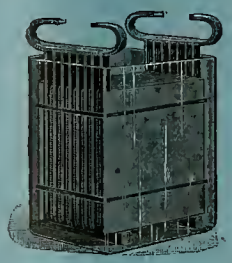

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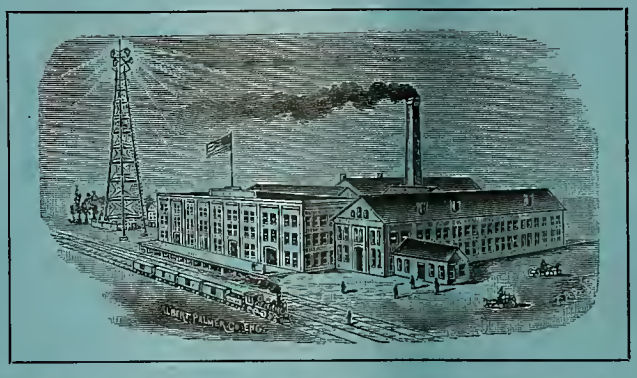

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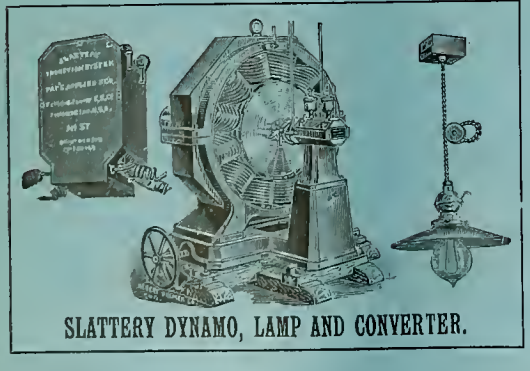

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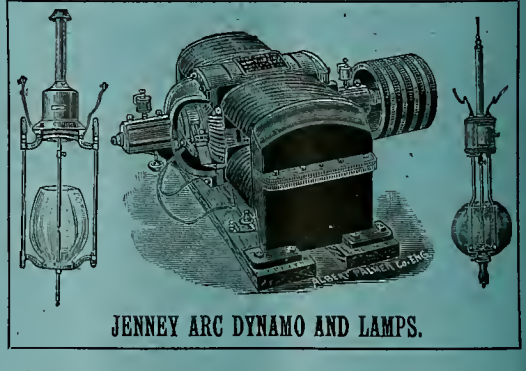

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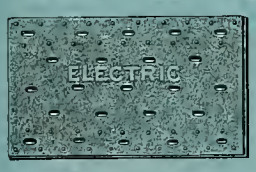

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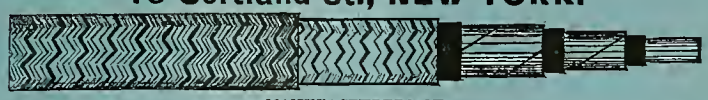

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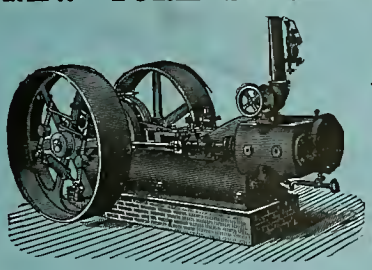

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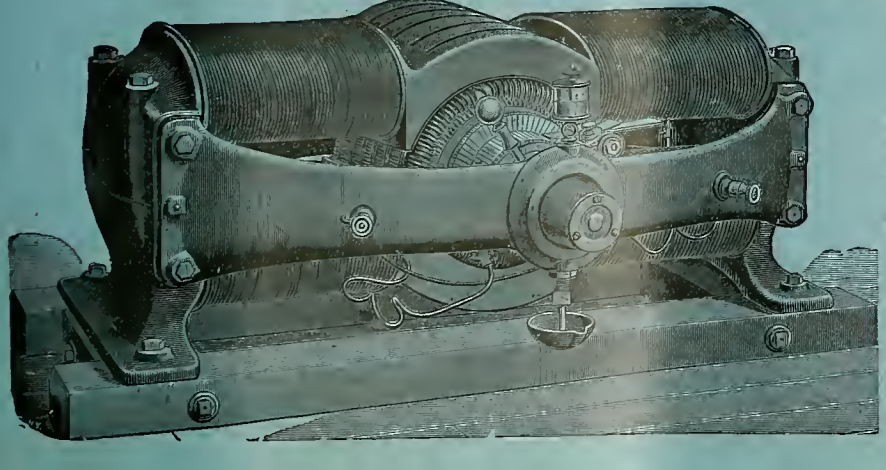

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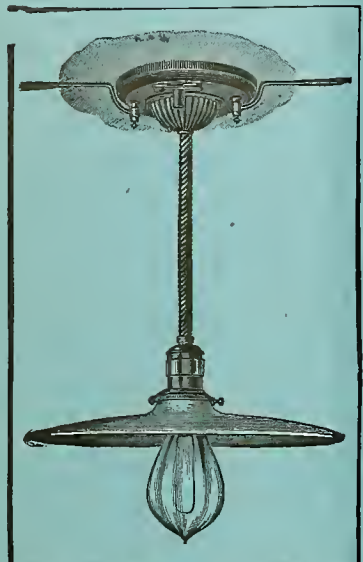

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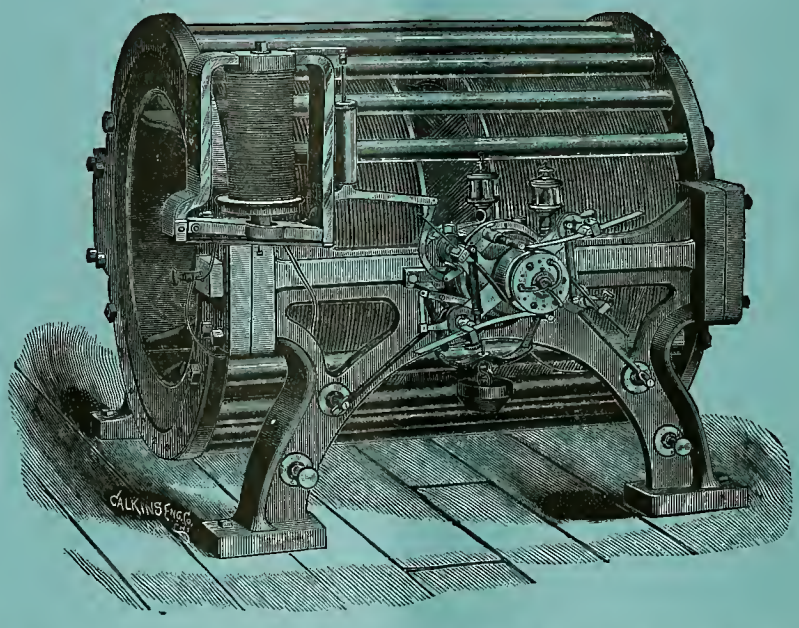

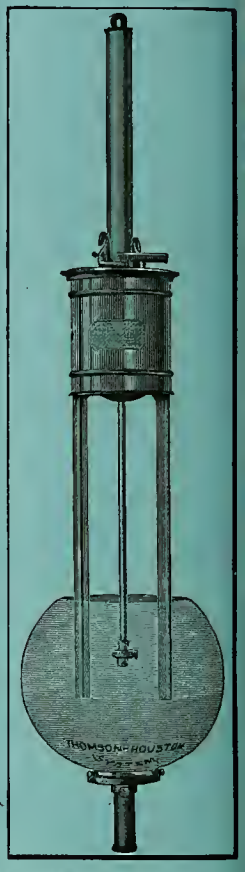

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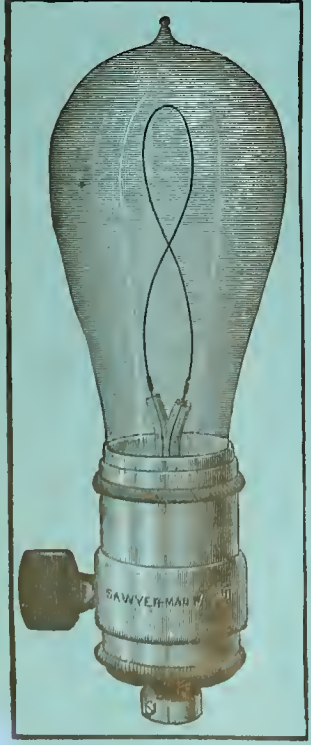

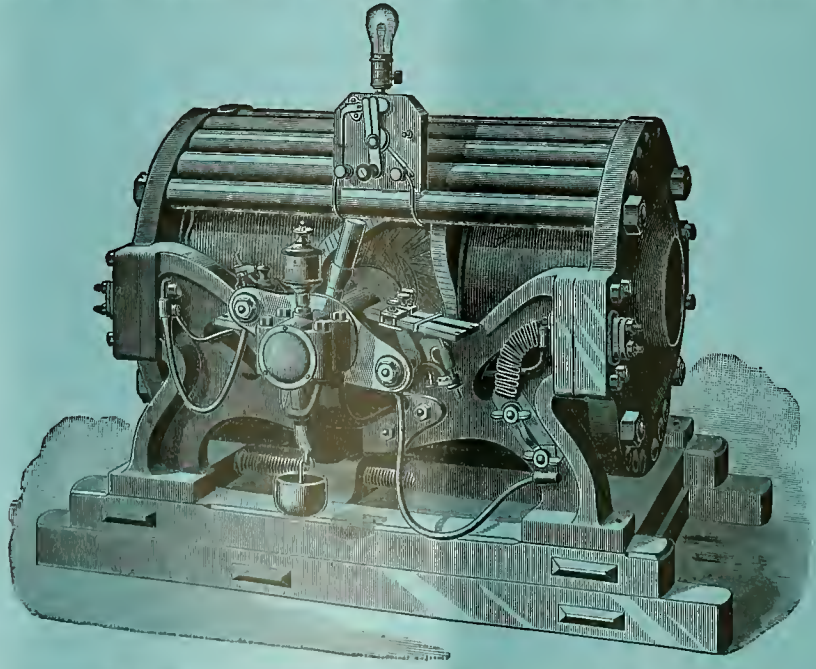

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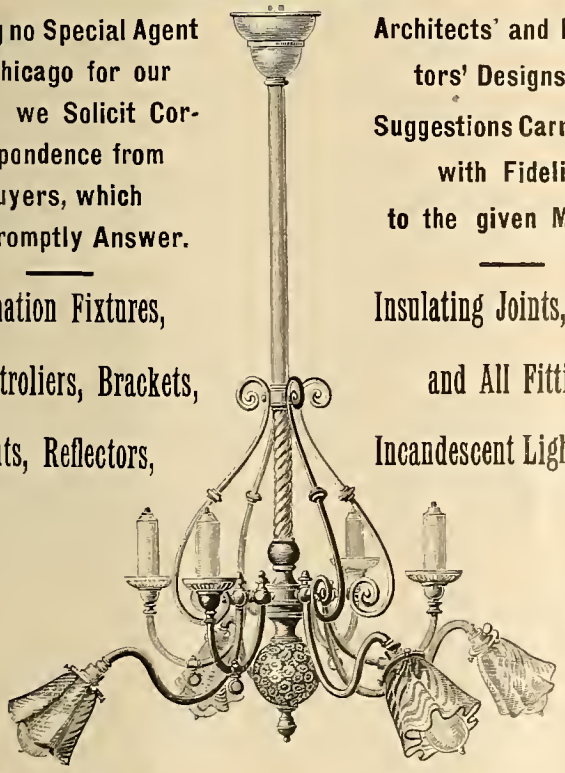

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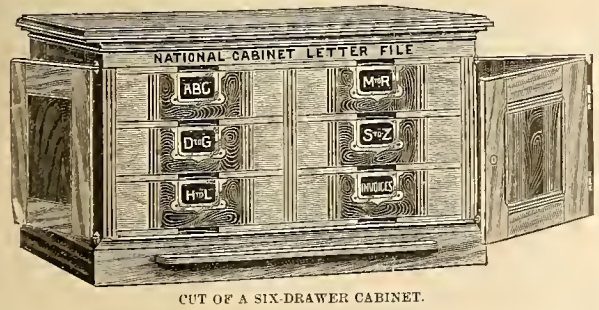

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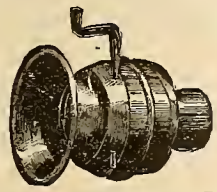

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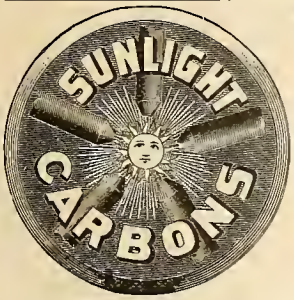

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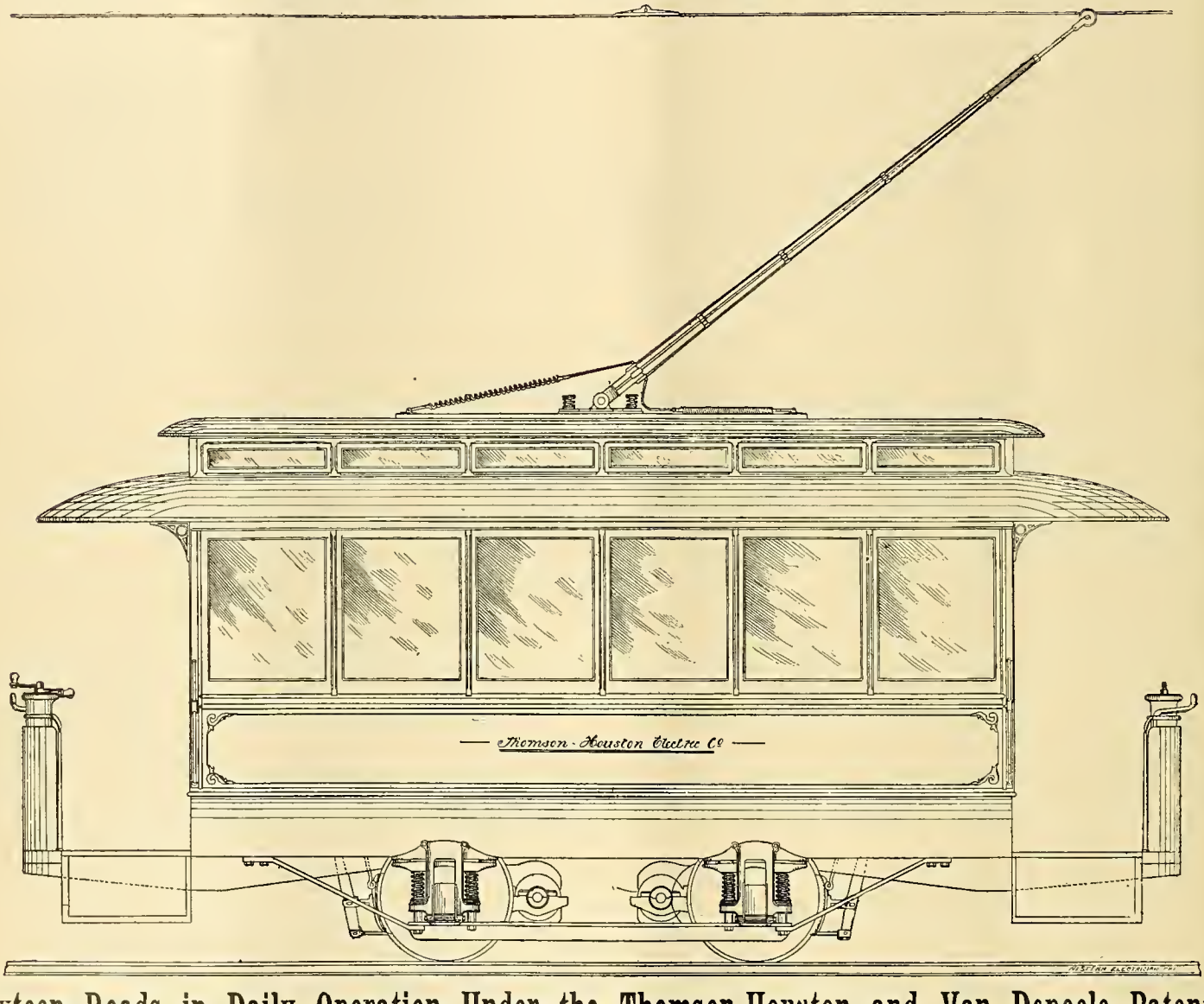

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Western Electrician.

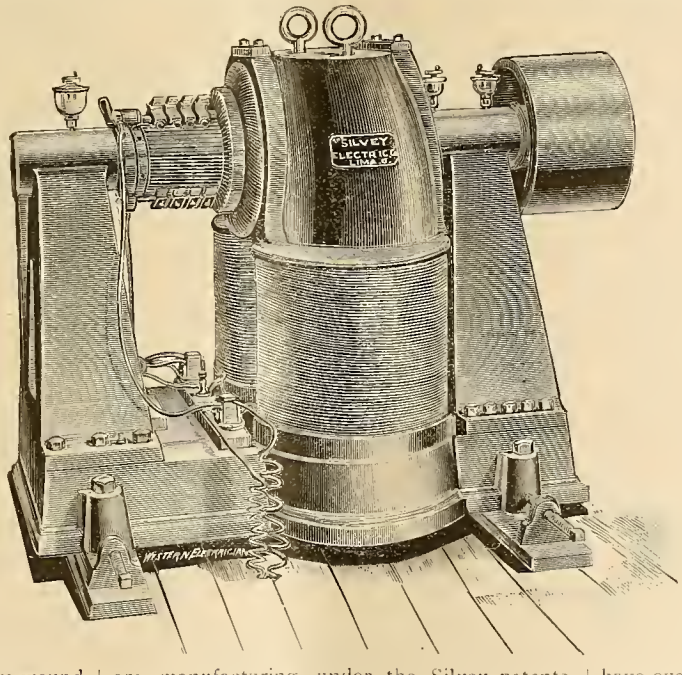
EVERY SATURDAY.

Vol. III. CHICAGO, OCTOBER 6, 1888. No. 14.

The Silvey Dynamo

The illustration in connection represents one of the latest achievements of W. L. Silvey, of Lima, O., an electrician whose name is widely known in connection with the Silvey electric headlight for locomotives. Mr. Silvey designed a dynamo five or six years ago, and the outcome of his experience, tests and experiments is seen in the engraving. This dynamo has been in operation for some time, running the entire system of the Lima Electric Street Railway & Motor company at Lima, O.

The machine has an electrical output of 120,000 watts. The field magnet core is 15 inches in diameter and 18 inches in length inside the coils. The entire field magnet and pole piece is cast in one solid piece and weighs 1,750 pounds. The heel plate, which also serves as the base of the machine, weighs 2,500 pounds, the heel plate proper being a solid block of iron 8 inches thick, 21 inches wide, and 47 inches long.



Around the two upright limbs there are wound 5,500 turns of No. 8 B. & S. insulated wire, having a total resistance of 22 ohms. The extreme height of the machine is 49½ inches; extreme width, 47 inches, and extreme length, 61 inches; total weight about 3½ tons.

The field magnets are excited by a small dynamo having an electromotive force of 180 volts, and 8.18 amperes. This gives the field magnets an exciting current of 44,990 ampere turns.

The armature is 18 inches diameter and 18 inches in length, wound with 320 turns of .25 square wire—four turns to each section in the commutator. It runs at a speed of 800 revolutions per minute, and gives an output of 600 volts.

Owing to the extremely small quantity of wire and low resistance of the armature there is no perceptible change in the current under the greatest variation in load, and little or no sparking at the brushes.

The cars are lighted by incandescent lamps, six lamps of 100 volts each being placed in series in each car.

There are in use on the line at present six 12 horse power motors and two 20 horse power motors, the latter being arranged to pull an extra car each, and at a speed of fifteen miles per hour.

In addition to the Main street line there is a branch running out West Market street, and to the cemetery and ball grounds. About half way out on this line there is a steep hill, nearly one-half mile long, having an ascent of 5 per cent. Recently a test was made on this hill with a 15 horse power motor of the Silvey system; 175 passengers in an attached car were carried up the incline at no particular decrease of speed. October 1st another Silvey motor of 20 horse power was placed on the line, and two extra cars thus added to the equipment. This gives the line a capacity of nine motors and twelve cars. In addition current is furnished for driving a 4 horse power Silvey stationary motor that runs a freight elevator at the wholesale grocery house of J. M. Sealts & Co.

The Silvey Electric company of Lima, O., who are manufacturing under the Silvey patents, have met with so great a success in their street railway system and general motive power that they intend giving that branch of their business very careful attention in the future. They will by no means, however, discontinue the manufacture of their dynamos for arc and incandescent lighting.

Electric Road at Alliance, O.

The Thomson-Houston company of Chicago, through Theo. P. Bailey, manager of the railway department, has closed a contract for the installation of an electric street railroad at Alliance, O. The contracting company will construct the plant complete, including power station and road bed. The company to which the sale has been made was organized to operate a horse car line, but after a careful investigation learned the advantages of the electric system, and very sensibly decided upon the better motive power. The road will be in operation in about six weeks. The cars will be of the latest design, and will embody all the recent improvements.

German Electrical Field.

Enos M. Barton, president of the Western Electric company of Chicago, returned from his European tour last week. In an informal talk about his trip Mr. Barton said to a representative of the WESTERN ELECTRICIAN: "I did not go outside the German speaking countries in my trip. Arc lighting has made but little progress there. A few places in Westphalia, through which I traveled, looked at night like American cities with arc lights in the stations and on the streets. The reason for the lack of progress is to be assigned, I conjecture, to the difficulties encountered in connection with securing rights of way. The 'mental inertia' of the people may also be considered a cause. Berlin may be regarded as an exception. During the six or eight weeks I was in the city the arc lights which had been practically confined to one square were extended to two of the principal streets. Those engaged in the work seemed to have overcome the difficulties connected with the right of way and were extending the street light system rapidly. The work has been done with underground cables, for which the streets and sidewalks were dug up. I was reminded of an American city. There is a good deal of incandescent lighting in Berlin, and in a few large cities. My impression is that Berlin is the most progressive city in incandescent lighting.

"Practically all the telephone wires are run overhead in German cities. The wires on the building are handsome fixtures. The construction is very neat as it is all done by the government in a way to avoid objection and criticism on the part of the public. It seems to be the policy of the government to extend the long distance lines. There is a good service between Berlin and Hamburg and a line from Berlin to Dresden is now building.

"The telegraph service in Germany is fairly well conducted considering that it is a bureau of the postoffice department. The delivery service and the convenience of sending messages are about all that could be asked. Their transmission of messages is not as prompt as that which we are accustomed to here."

A Pulsatory Current System.

Among the patents issued September 25th is one to Gustav Pfannkuche of Exeter, N. H., and Alfred Pfannkuche of Cleveland, O., entitled a "System for the distribution of electric energy." The invention relates to those systems of distribution in which converters are employed to alter the character of the electrical current before it is consumed. It aims to provide a system of inductive distribution which shall possess all the material advantages and be free from the objections inherent in the multiple arc low tension incandescent and the alternating high tension systems. To this end a dynamo of special construction is employed; it generates currents neither alternating nor intermittent, but of continuous direction, made up of successive waves or pulsations, and having sufficient potential and being of sufficient volume to adapt them to the conditions for which, in any particular case, they may be designed. The patent specification thus outlines the advantages of the pulsatory current: "The pulsatory current of continuous direction possesses the essential capabilities of both an alternating and a continuous current. For producing inductive effects it is equally as available as an alternating current, since it is subject to the same incessant rise and fall of potential. In order to substitute such a current for an alternating one, it is only necessary that it shall possess fluctuations of electromotive force equal in degree to the difference between the opposite extremes of positive and negative potential in the alternating current and recurring with corresponding rapidity, in which case the inductive result will be the same as with the alternating current which has been superseded. Thus such a pulsatory current is suitable for use on the primary circuit of an inductive system of electric distribution in lieu of an alternating current. The pulsatory current of continuous direction is also essentially identical with a uniformly continuous current, since it produces the same effect, and may be used in substitution therefor for identical purposes. Both the uniformly continuous and the pulsatory currents will operate arc lamps, will decompose water, will serve for electrolysis, for charging secondary batteries, for running electro motors, etc., it being only necessary that the waves or impulses shall succeed each other with sufficient rapidity. For such uses the pulsatory current develops an available electromotive force equivalent to the average of the varying potentials; or, to illustrate it graphically, the available potential is denoted by a line at such height above the zero line as shall inclose for any given length an area equal to the sums of the areas inclosed by the sinuosidal curves of potentials for an equal length."

The cut in connection illustrates a distributing system in accordance with the invention which is utilized for various industrial purposes in addition to the maintenance of secondary currents for feeding incandescent lamps, this view being designed to illustrate the applicability of the invention to various uses. The cut shows two arc lamps, *E E*, joined to the main line in multiple arc, an electro-motor, *F*, connected in like manner, and an electro-plating bath, *G*, and accumulator or secondary battery *H*, connected serially in a derivation of the main circuit. The converters *C C*, of which five are shown, have their primary coils connected to the main line in multiple arc, and the secondary circuits, of which three are shown are connected to local circuits, D^1 D^2 D^3.

"For the operation of the devices *E*, *F*, *G*, and *H* the pulsatory current has the same effect as a uniformly continuous current, while, on the contrary, for the operation of the converters the same current has the effect of an interrupted or alternating current, in that it induces secondary currents in the parallel wires of the induction coils. This applicability of the current from one dynamo to a great variety of diverse uses is a feature of the invention which, it is claimed, will prove of great advantage, since it enables one dynamo and one line circuit to serve the purpose for which heretofore at least two distinct dynamos and circuits have been required—an advantage which will be especially valuable for small installations—as, for instance, in those employed in a single factory where a variety of operations are being carried on by electrical aid."

Pullman Electric Road.

Ground was broken for the new electric road at Pullman, Ill., on Sept. 18th. The road will run north and south, from One Hundred and Fourth to One Hundred and Fifteenth street, and will be about four miles in length. Loss & Co., of Rochester, N. Y., have the contract for the track-laying. C. E. Loss, who is superintending the work, says that he can complete the contract in thirty days, if necessary. Certain it is that the road will be in operation late in the fall, though electricity may not be the motive power until later. Several statements have been made concerning the system to be employed. A Chicago daily paper is authority for the report that both the conduit and overhead systems will be used. Mr. Pullman, who is of course the leading spirit in the construction of the road, said to a representative of the WESTERN ELECTRICIAN:

"We have not decided on the system which we will use, in spite of newspaper reports to the contrary. All that we have determined definitely is that it shall be an electric road. We do not want to take any backward steps in this matter. When we decide upon a motor we want to have the best, and whether we shall use conduits or an overhead system is still a question, and I am prepared to say I know as much about the matter as any one."

"What is the object in building the road?" was asked.

"We expect that the road will be self-sustaining. There is a population large enough for that. We intend to lay out the road so that it can be used to test cars which we manufacture. If, for example, cars are to be run on a road that has sharp curves, we can put them on the line and ascertain if they work satisfactorily. If they do they will work just as well a thousand miles distant. We can tell a man who is investigating the question of an electric road, 'There is a line which combines all the difficulties of any road with the exception of grades, and all these difficulties are overcome.' Then we can test on the road cars intended for other than electric roads."

"When will the new line be in operation?"

"It will be in operation before winter, but possibly electricity will not be the motive power by that time. We may decide on a system within ten days, and possibly not for a few months."

The cars to be used on the new line are to be 33 feet 10 inches long, and they will be as elegant as it is possible to manufacture. They will form a permanent exhibition of Pullman work, and as such no pains will be spared to fit them up in the handsomest style.

C. E. Loss is a firm believer in electric roads. He says, beyond all question, electricity will form the motive power for street car lines in the future.

When the electric road is completed Pullman will be even a more interesting place, and will attract still greater attention. It is a thriving, bustling town, abreast of the times, and for that reason, if no other, it should have an electric road.

The dispute existing between the Standard Carbon company of Cleveland and its principal stockholder, W. H. Boulton, was referred to in the issue of Aug. 25th. At the hearing of the case Mr. Boulton asked the court for the appointment of a receiver on the ground that the company's business was improperly conducted, and that it was in danger of becoming insolvent. Judge Hamilton refused the petition, and the injunction restraining Mr. Boulton from interfering with the company's property was continued until the final hearing.

Chicago Electric Club.

The Chicago Electric club held its first fall meeting last Monday evening, with President Barton in the chair.

The minutes of the last meeting were read and approved. The membership committee reported that eight new names had been added to the roll, and that less than $129 was still owing for dues by delinquent members.

C. A. Brown had been announced to read a paper, but in view of the fact that there was a small attendance, owing no doubt to the delay in issuing notices of the meeting, and the further fact that the question of a club house was to come up for discussion, the reading of the paper was postponed until the next regular meeting.

B. E. Sunny, C. A. Brown, C. D. Shain, W. A Kreidler, W. J. Buckley and President Barton took part in the informal consideration of the subject of a club house.

Three locations for new quarters were referred to in the discussion: Rooms in the business district, a single house the committee had found vacant at 18 Harrison street, comparatively near the south side business district, and a house in the residence district, the latter necessitating, of course, a journey by street cars. It was stated that nearly or quite all the expense of rent of a house could be met by the income from members who would engage sleeping rooms in it.

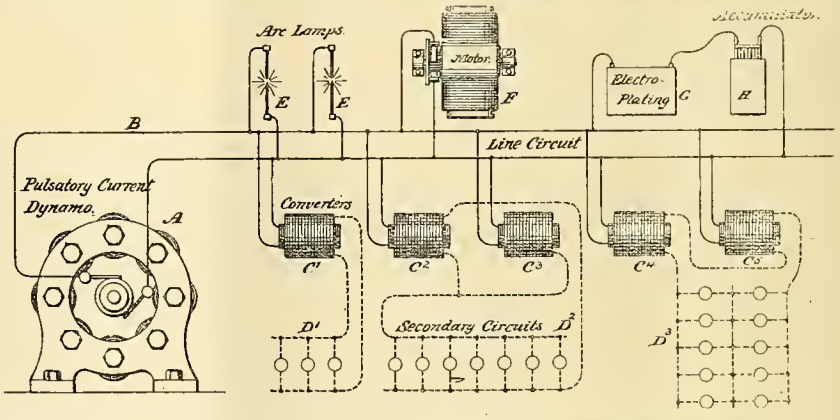
No formal action was taken, but the committee will pursue their investigations, and at the next meeting, October 15th, probably decisive action will be taken.

The subject of an electric exchange will also come up for consideration at the next meeting.

President Barton in a happy speech introduced President S. A. Duncan of the National Electric Light association, who said that it might be thought that the discussion in regard to new quarters was very tame and uninteresting to him; on the contrary, the reverse was the case. He said that very rarely was a club house of the character of that proposed by the club found in the center of any large city. "You will find large political or commercial clubs like those of Chicago, Pittsburgh, New York and Boston, where men congregate, whose business interests are such that a daily interchange of ideas was very valuable. But such clubs mean large memberships and large dues." The need of a permanent home as expressed in the discussion he regarded as a very healthful sign of growth. He believed that conservatism should be exercised in selecting quarters.

He congratulated the club on the very excellent papers that were prepared by its members and presented at the meetings last winter. He had read them carefully, and knew that others had read them as carefully as he had.

President Barton spoke of the phenomenal growth of the electrical field and its evolution of bright, shrewd business men who frequently came into competition. He believed in the social feature of the club, and desired a place where those who were competitors in business might meet and have a social time. So far as scientific attainments were concerned, he fully believed that the Chicago Electric club would compare favorably with any other club. He urged the necessity of uniting all men in this vicinity engaged in electrical pursuits, such as telephone and telegraph men, engineers and linemen, with the club, and said that the social feature of the club was what was going to be its life, its vitality. He thought the enthusiasm manifested by the board of managers should be shared by every member.



Lightning Notes.

In his work on "The Thunderstorm" M. Sestier gives the following statistics: "Only a minority of lightning accidents are fatal; in 601 cases there were only 250 deaths. Fatal accidents are more frequent in men than in women; of 307 men struck by lightning 165 were killed, while of 137 women only 51 perished. In the vast majority of cases —340 out of 354—death was instantaneous. The danger is greatest in buildings and places (churches, schools, etc.) where crowds of people are gathered together. The part most often struck is the head, then the chest and limbs. In cases in which the head is struck the mortality is double what it is when only the trunk or limbs are injured."

According to Ch. Moussette most of the peculiarities noticed in photographs of lightning flashes arise from accidental vibrations caused by the wind, the thunder, or the shaking of the earth. In order to prove this he made a white on black drawing of flashes inclined at different angles. This drawing was photographed in two ways: First, with the camera carefully secured from vibration; secondly, with the camera slighty jerked at the moment of photographing. In the first case the flashes came out fine and clearly defined; in the second case the flashes presented the appearance of striated ribbons, except where the lines of the drawing were parallel to the direction of motion of the camera.

Galvanic Batteries.

By C. H. Rudd.

In these days of mechanical generation of electricity it might seem unprofitable to spend time upon the servant of other days, viz.: the galvanic battery. However, many minds are still working in the old field, and there is room for good work in that direction. It is interesting to consider that most of our knowledge of electricity is practical—we know what it does. Many points which we reach after, with the feeling that the understanding is able to grasp them, elude our search, and we remain in the dark concerning them. As regards batteries, I am impressed with the idea that much which passes for truth in the minds of those using them is not proved. There are popular beliefs which experience seems to sustain, and it would be bold assumption on my part to attempt to overthrow them. Time will doubtless show that some rules in the treatment of batteries, which are now followed blindly, are based upon sound principles; for example, there are those who insist that the gravity battery should be kept in a dark room. A better knowledge of the effect of light upon various substances may reveal reasons why this is a wise precaution.

A study of the subject before us brings out some points of interest in the production of electricity. The battery is looked upon as a very expensive agent, because zinc is so costly as compared with coal. The reason why batteries have been used so long for telegraph purposes is that the work accomplished bears no relation to the mechanical energy employed in doing it. A telegram is usually worth hundreds of times the cost of the zinc consumed in sending it. In electric lighting and for power the case is different. In these pursuits the cost of zinc becomes an element of large value. If pure zinc were found in nature as coal is, cheap electricity would abound. We are already able to make batteries self-sustaining save in the matter of zinc. In making a constant battery a leading necessity is that there be a good depolarizer. For this purpose the most perfect material is nitric acid. Polarization is caused by the gathering of hydrogen upon the negative electrode. Any substance which will combine with this hydrogen serves as a depolarizer. If the negative electrode is surrounded by nitric acid the oxygen of the acid combines freely with the freshly forming hydrogen, and keeps back the counter electromotive force which would be set up by the hydrogen. The Callaud battery is depolarized by the aid of the sulphate of copper. In the action of the battery the sulphate of copper is broken up, the copper being thrown down, and the remainder passing over to unite with the zinc of the oxide of zinc, forming zinc sulphate, and leaving free oxygen to unite with the hydrogen, forming water.

In the Leclanche battery manganese dioxide acts as the depolarizer, but in an imperfect manner; therefore the Leclanche battery is not constant. In spite of its inconstancy the Leclanche battery is largely used. Its value lies in the fact that it undergoes but little change while standing idle. It will keep in good condition for months of absolute rest, which is not the case with most batteries. The Leclanche

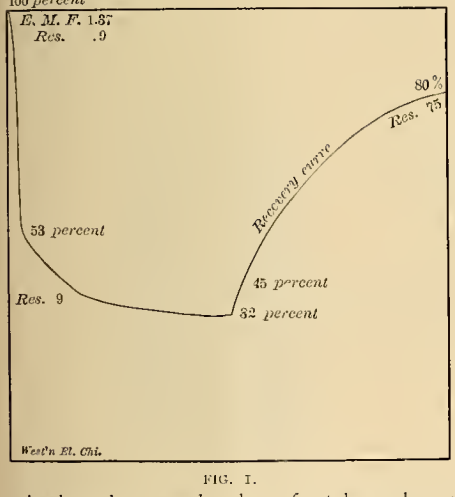


FIG. 1.

battery has been the subject of much study, and is being put to various tests to determine the amount of variation in its electromotive force when in action. One form of test is to put a cell or two at work on a vibrating bell. Some cells will keep a bell in constant action for three months or more if zinc be supplied as fast as it is consumed. Another method of testing is to arrange a circuit closer upon a rolling shaft, so that the battery will be closed at regular intervals and made to do about the same work that it would do if in actual service. By watching the electromotive force and resistance of a battery so tested an idea may be formed of the value of the depolarizer, and the character of the service rendered.

During the past few months I have made some tests of batteries in the following manner: After measuring the electromotive force and resistance I closed the battery through about the resistance that it would find in a telephone transmitter set, and watched the fall of electromotive force, taking a reading on a reflecting galvanometer at the end of each minute for twenty minutes. The electromotive force was usually pretty constant after ten minutes. At the end of the twenty minutes I noted the internal resistance, and then opened the circuit. I then watched the rise of electromotive force for twenty minutes, taking readings as before. At the end of the twenty minutes I noticed the resistance again. From the deflections obtained it is possible to make diagrams, which show the character of the work done. Fig. 1 and Fig. 2 are examples.

Fig. 1 is a diagram taken from a cell made in the form of the Leclanche, but with no dioxide of manganese. It will be seen that the e. m. f. fell to 53 per cent. of its original strength after one minute of work, and then fell by an easy curve to 32 per cent. At this point the cell was allowed to recover, and rose during the first minute to 45 per cent. of its original strength; rose during the remainder of the twenty minutes to 80 per cent. of its original strength. The e. m. f. at the start was 1.37; resistance at start, .9 ohm. Resistance at the lowest point in the e. m. f. was .9, and at the end of the recovery curve was .75.

Fig. 2 is a diagram taken from a cell made in the form of a Leclanche, but having the crushed carbon left out. The carbon plate was surrounded by clear dioxide of manganese. The cell was made to work through an exterior resistance of 9 ohms. It will be seen that it fell to 56 per cent. of its original strength during the first minute, and then gradually fell to 50 per cent. During the first minute of recovery it rose to 52 per cent. of its original strength, and then during the remainder of the twenty minutes gradually rose to 88 per cent. The e. m. f. at the start was 1.75; resistance at start, 9 ohms. Resistance at lowest point in the e. m. f. was 10 ohms, and at the end of the recovery curve, 10 ohms. A greater degree of accuracy would be reached if the observations were made upon several cells at once, connected in series. In making diagrams that shall present the relative value of batteries correctly to the eye the closed circuit should carry the same current at the beginning of each test.

Women as Telegraphers.

A correspondent in the St. Louis *Globe-Democrat* writes as follows of the female telegraph operators in New York Western Union office:

Some of the women were handsome. All were tastily dressed. The majority looked rosy and healthy. They all wore a jaunty air, as well as fashionably cut gowns. Some were busy sending or receiving messages. Those who hadn't any messages to send were reading books or papers. Some were engaged in fancy work or knitting. It was a great big happy family, and the occasional ring of a woman's musical voice was heard above the Niagara of clicks.

"Is the telegraph business a good one for women to engage in?" I asked him.

"Yes," was Mr. Dealy's reply. "A woman who is smart and quick and wants to earn her own living can do so very comfortably if she be a good operator."

"Does the supply equal the demand?"

"Yes, a dozen times over, but good smart women are always wanted. We receive a great many applications from women who want work. They come from all parts of the country and are carefully filed away. As soon as a vacancy occurs we take the first application on file and give whoever happens to be that lucky heroine the first chance. We have applications on file now from women received full one year and a half ago."

"What time is necessary to prepare a young woman for a telegraph operator?"

"That depends. A naturally smart woman will learn much faster than a woman who isn't quick and ambitious. Much depends upon their previous education. Women well versed in a variety of subjects, who can read difficult manuscript, who can spell correctly, who can supply deficiencies in messages; in a word, women who are smart can become good operators in a year. Others require from one to three years to become first-class operators. Women are oftener more reliable than men, and we have some who are quite as expert as their brothers of the key. How are women paid? Beginners are paid $15 a month. When they can operate fairly well their pay is increased to $25 per month. Then as they improve their pay is still further advanced until they reach the average pay—from $50 to $75 per month, according to experience and ability. Women operators work nine hours a day, usually from 9 A. M. to 5:30 P. M., with a half-hour at

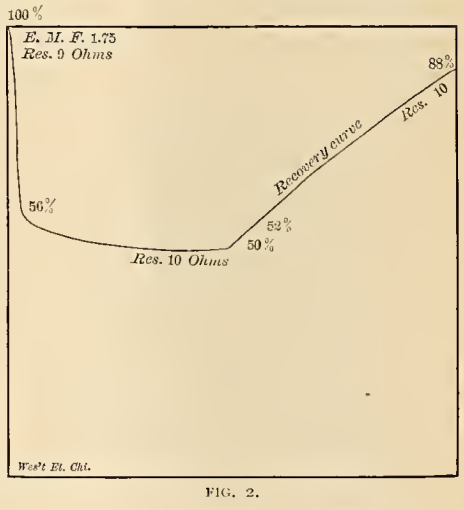


FIG. 2.

midday for lunch. They are shown no more favors than the men. They are required to keep their wires clear of messages. When they are not engaged they may either read or sew, paint, do fancy work, or whatever else they choose. Yes, we have a good deal of talent here. Any number of our operators earn money after their regular labor is finished. Two write for the newspapers. Others sing in church choirs. A few give lessons in music, and one teaches a dancing class in the evening. One of our best operators is Mrs. W. E. Randolph. She is a widow and sings in Plymouth Church choir. She is also a very clever verse writer, and a poem she wrote at the time of Henry Ward Beecher's death attracted a good deal of attention. She has been an operator for many years, and is a good one, too.

"My long experience has taught me that in many respects women operators are better workers than men, but altogether not so useful. They are steady, give no trouble, are absent less frequently than men, and seem to feel a keener responsibility. Quite a number of women operators have been with us for ten years. Their work gives them a deep insight into human nature. They learn to carry themselves with dignity. They cast aside all frivolous ideas. They make good wives, and their work does not unfit them for feminine duties. Scandal? No, sir. Never heard of any in all my long experience here. Their presence has a soothing effect upon men, and many a woman has listened to Cupid's honeyed words as she sat at her key, and has found a loving, honest husband in a near-by telegraph operator. Telegraphy isn't as prosaic work as some people imagine. There is a heap of romance about it. What a book some of the old operators could write!"

New Form of Law Battery.

The latest form of Law battery is illustrated in the cuts on this page, Fig. 1 showing the cell complete, Fig. 2, the negative element. As will be noted the latter consists of two cylinders of carbons, one within the other, thus presenting a large surface for action. The advantages of this form of construction lie in the fewer number of parts and in bolting the negative element to the cover instead of sealing it by cement. On account of the quantity and large surface of the carbon, it is claimed that the battery holds up under hard work, or when overworked as long as other batteries containing manganese or other substances to accomplish depolarization by chemical action.

Telephone Lines and Heavy Electric Currents.

The German Society of Electricians in November last appointed a committee to investigate the conditions under which telephone circuits can be efficiently operated in the neighborhood of cables carrying heavy currents, such as are used for electric lighting and transmission of energy, says *Industries*. The problem put before the committee was formulated as follows: (a) How are telephone currents influenced by heavy electric lighting and power currents in their neighborhood? and (b) what conditions of installation and working heavy current circuits should be observed in order to avoid interference with neighboring telephone circuits? The committee, as originally constituted, contained ten members, but they added four other members of the society to their number, and elected a

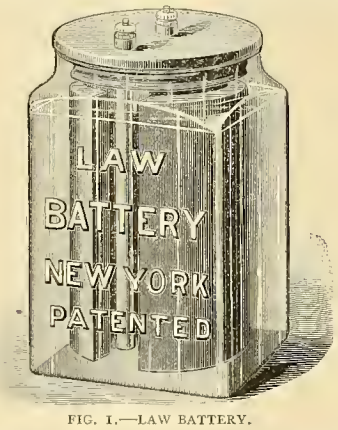


FIG. 1.—LAW BATTERY.

sub-committee to prepare the experiments. The committee have now presented their report, which is printed in the society's journal for August. The space at our disposal does not permit us to give a full translation of this report, and we must content ourselves with citing only a few of the experiments, and giving the general conclusions arrived at by the committee.

EXPERIMENT I.—The testing wire of an electric light cable 500 meters long, and carrying a continuous current, was used for telephonic communication, with the result that, in addition to the ordinary noises heard in the telephone, there was a disagreeable and persistent surging sound which greatly interfered with the clearness of transmitted speech.

EXPERIMENT III.—A telephone cable drawn through an iron pipe was placed underground at a distance of 1 to 1½ meters from, and for a length of 550 meters parallel with, several electric light cables carrying continuous currents. No noises, other than those usual, were heard in the telephone, and conversation over the telephone line was quite satisfactory.

EXPERIMENT IV.—In this experiment an overhead telephone circuit was used, passing over a railway station lighted by alternating currents. The telephone wire crossed the main cables at right angles, but was about 20 meters above the dynamo room. Notwithstanding this disposition, there was produced in the telephone a humming noise which greatly interfered with the transmission of speech.

EXPERIMENT VIII.—An alternating current of 120 amperes was sent through a concentric cable, and an insulated telephone wire was laid underground by the side of it. No noises were heard in the telephone.

EXPERIMENT IX.—Instead of a concentric cable, two single cables were used, carrying a current of 58 amperes, and placed 15cm. apart, the telephone wire being laid midway between them. In the telephone there was noticed a low whistling sound, but not sufficiently strong to interfere with communication.

EXPERIMENT X.—The electric light circuit was arranged as in the previous experiment, but the telephone wire was placed outside of them, with the result of inducing a humming noise in the telephone which greatly impeded communication.

Further experiments were made to ascertain the effect of an iron armature on the cables, and a metallic return for the telephone circuit. It was found that telephonic communication remained undisturbed by neighboring heavy currents if the lead sheathing of the telephone cable was used as a return circuit. Where, however, earth was used, noises could be detected in the telephone, and it was also found that the influence of heavy currents upon neighboring telephone circuits depended upon the earth resistance of the latter.

The general conclusion arrived at by the committee is that it is not possible to give the precise limit for the distance at which parallel telephone circuits and cables carrying heavy currents should be placed in order to avoid interference, but that this distance should be made as large as possible, not only to reduce induction, but also with regard to the greater mechanical safety of the telephone circuits. Where alternating currents are used, interference can be avoided only if both the positive and negative mains are equidistant from the telephone circuit, a condition which is fulfilled by the employment of the Siemens concentric cable. The same arrangement is also advisable where continuous currents are used. Interference is avoided if the telephone circuit is operated with a metallic return placed close to the outgoing wire. The report concludes with a recommendation that telephone and electric light or power circuits should be placed as far apart as possible, and should be protected by a metallic armature. It will be seen from the above brief review of the labor of the committee that the results they have obtained are in accordance with the generally accepted views on the subject, and that the recommendations are of such a nature as would naturally be adopted by any competent electric light or telephone engineer, even had these long series of experiments not been undertaken.

Alternating Work of the Fort Wayne Jenney Company.

The rapid progress of the alternating systems in the United States is being watched with genuine satisfaction by all who have at heart the increased usefulness of electric lighting generally, and an interest in its further extension to fields where the introduction of electricity has hitherto been impracticable.

The Slattery induction system manufactured by the Fort Wayne Jenney Electric Light company of Fort Wayne, Ind., was first prominently brought to the attention of the world by the illustration and description of the system which appeared in the electrical papers at the time of the Pittsburgh electric light convention—only last February. At that time practically nothing had been done in the way of installing plants of this system, and it is interesting to notice how much has been done since then in the way of putting out operating plants. Since that time, as will be seen from the following, the growth of the business has been such as to bring it within the category of enormous.

Harlem, N. Y., has a plant of 2,000 lights. The successful operation of this plant has attracted attention in New York, and as the result, a new plant which will start off with a capacity of 10,000 lights, is being installed at 80th street and Avenue B in New York city. A large building is in course of erection at this point, and it is expected that at least 20,000 lights will be needed before the ultimate needs of the territory are satisfied. So urgent has been the demand for lights that the company has been obliged to put in operation temporarily two 1,000 light machines at the Brush company's station in 25th street to run until the station at Avenue B is completed. In Fort Wayne 1,000 alternating lights are now in operation, and it has just been decided to build a larger and much more complete station at Fort Wayne for the accommodation of the arc and incandescent business, and this new station will have a capacity for probably 5,000 alternating lights. The present 1,000 lights are in use for commercial lighting in Fort Wayne, and it is expected that another 1,000 can be put to the same use as soon as the station has the proper capacity. The additional lights above this 2,000 will be used more especially to accommodate the residence part of the city. The Wayne hotel, which by the way is the handsomest and best managed hotel in Fort Wayne, is very handsomely lighted by the Slattery system.

Other Slattery induction plants are: Columbia City, Ind., 400 lights; Eau Claire, Wis., 1,00 ; Utica, N. Y , 2,000; Galena, Ill., 500; Brainerd, Minn., 1,000; Dallas, Tex., 2,000, with a probable capacity for 5,000; Beaumont, Tex., 500; Saginaw, Mich., 1,000; Logansport, Ind., 1,000; Plymouth, Ind., 500.

The foregoing list of plants, all of which are either in operation or in course of construction, certainly makes a very handsome showing since February. It is also a tribute to the general excellence of the Slattery system and its adaptability to general conditions. The Fort Wayne company has practically given up the whole of its factory in Fort Wayne to the manufacture of alternating apparatus, although the whole of its arc business has not yet been transferred to Plymouth, Ind. When this transfer has been made all of the Fort Wayne building will be devoted exclusively to alternating work, and an additional building will be put up at once. The company has its own brass foundry, and makes its own brass castings. The department for the manufacture of lamps has now reached a point where a large number of lamps is turned out weekly, though the demand for the apparatus is so great that the lamp department is not yet able to supply the full number of lamps needed to go with the dynamos that are shipped out. A new room has recently been added for testing dynamos, and a handsome new office building is to be erected shortly, and also a laboratory building 30x40 feet in size, fully equipped with power, instruments of precision, etc., for Mr. Slattery's use. The erection of the new office building will give the draughting and designing departments more much-needed room.

Mr. Slattery divides his time between overseeing the erection of new stations, and construction and experimental work in the shop. His new alternating motor is nearly ready to be put upon the market, and some of his latest ideas in this direction will be embodied in this apparatus, as also in his new alternating meter which is also about ready to be sent out.

The Fort Wayne company, while devoting a large part of its energies and facilities to the alternating part of its business, is not by any means neglecting its arc light department, as witness the list of arc light plants which we published a week or so ago. Since then Bloomington, which was noticed last week, has been secured, and Gallion, Ohio. The latter place will take 76 arcs and 400 to 800 incandescents. Altogether, it will be seen that the Fort

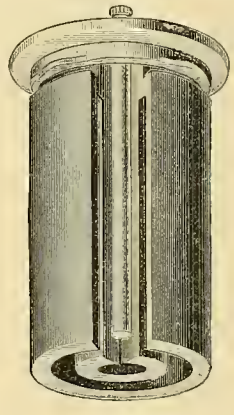


FIG. 2.—LAW BATTERY.

Wayne company is rapidly going ahead in all of its departments, thanks to the energy and push of general manager R. T. McDonald, and the inventive skill and versatility of M. M. M. Slattery.

Electric Lights in the Lumber Business.

Electric lights have become an important factor in the lumber business. More than the usual number of mills are being run day and night this season, and electric is now the only light countenanced in sawmills, says the *Mississippi Valley Lumberman*. The risk from any other kind of a light, even though it were possessed—as it is not—of the same luminous qualities, is too great to admit anything else being used. On the Mississippi River, too, the raft boats are able to move logs from Beef Slough and Lake St. Croix to the Middle Mississippi River without tying up at night, because of the introduction of the electric light, and the oscillating reflector, with which the pilot is able to penetrate the deepest darkness half a mile or more ahead. There has been a distinct advance made, too, in the character of electric lighting in the mill. The early electric plants consisted of arc lights, with their deep shadows and their deadly currents. Accidents in mills from these dangerous electric currents were not numerous, but they occurred, and there was an element of fire risk in these strongly charged wires. The insurance companies recognize this, and the underwriters in the different cities have given a great deal of attention to the subject, and made a great many stringent rules governing the placing of lights in buildings. The arc light is still in use in a good many saw mills, but latterly the adaptability of the incandescent light, not only to the lighting of sawmills, but in yards in which lumber from the mills is piled, has been so thoroughly proven that the time is at hand when the incandescent light will be the only one used in manufacturing plants.

"Practical Talks by Practical Men," a series of instructive lectures before the Twenty-third street branch of the Young Men's Christian association of New York, was inaugurated by Dr. Schuyler S. Wheeler, October 5th, who chose for his subject "Electricity—Its Modern Application." He was assisted by Francis B. Crocker

The New Electric Postal Road at Baltimore.

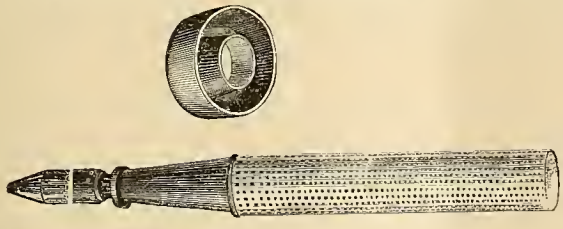
The Electro Automatic Transit company of Baltimore, which is the owner of the new Weems electric postal railway, recently illustrated in the WESTERN ELECTRICIAN, has erected near the city of Baltimore, at Laurel, an experimental track about two miles in length. The motive power for this road will be supplied entirely by electricity, and the cars will be controlled and the brakes applied by the same power. The speed which it is expected to attain is five miles per minute. Each car is built of sheet iron, is two feet square and about twenty-one feet long. Two cars constitute a train and when so joined they are connected after the vestibule pattern by a flexible connection the size of the car itself. The rails are three in number; one above carrying the current to the car, and two below constituting the return circuit.

The motors for this road will be of a special type and will be furnished by the Sprague Electric Railway & Motor company of New York. They will be of the most approved type, of 25 guaranteed horse power each, and especially adapted for this work. The power car will carry three motors, making 75 horse power available for driving each train. The power will be furnished by one Ball engine of 100 horse power.

The board of directors include such leading men in Baltimore as Alexander Brown, B. F. Gamble, Thos. W. Johnson, and Daniel G. Weems, general agent.

It is the intention to soon build two roads for carrying mails and other light freight, one between Baltimore and Washington, and the other between St. Paul and Chicago.

The company is also under contract with the English government to construct several postal roads in that country upon the demonstration of successful performance in this country.



An Automatic Torch.

An automatic torch designed especially for the use of electricians is shown in the cut above. The torch is made of solid brass and will stand a test of a thousand pounds hydraulic pressure. It is noteworthy for its extreme simplicity of construction; it has no wicks or wires to char, clog or renew; no movable parts to get out of order, and requires no pumping or blowing to get up a pressure. It is manufactured by the Electrical Supply company.

War on Aerial Wires in New York.

The recent war of the Subway commissioners upon the electric lighting companies broke out last week, says the New York *Sun* of September 24th, in hostilities of the fiercest and most uncompromising kind on the part of the commissioners, and everything along the line has been in a state of confusion for a week. The Subway authorities are on top in the fight. The Subway struggle grew out of the board's recent threat that if the electric light magnates didn't obey their orders they would make a raid on the aerial structures maintained by the companies. Monday last, workmen, armed with Subway axes and special orders from President Moss, started out to lay low the poles and wires. They began at Fourteenth street and Sixth avenue, and hewed down the poles in a triumphant march up the avenue. The poles were carted away as fast as they were chopped down. In the vigorous onslaught the warriors of the Subway spared only those poles that held the street corner electric lamps, and swept the others away all the way to Fifty-ninth street, on both sides of the avenue.

When they got to the Thirty-third street corner the warriors ran against a section of air-stretched wires that run up Broadway and another section that reaches up Sixth avenue. The assailants went back to Commissioner Moss for further orders, and the commissioner calmly told them to cut off the connection leading to Broadway and continue their devastation along Sixth avenue. The secretary of the Subway board at the same time waited on Captain Reilly at the Thirtieth street station-house and officially informed him of the decision of the commissioners, and said that the latter wanted policemen to guard the cut wires and see to it that electric light engineers didn't come any sharp tricks after dark, and re-establish the connections.

This was on Friday last, and in the afternoon of that day a Subway expert cut the central wire in a section of five wires that run over a pole at the southwest corner of Sixth avenue and Thirty-third street. The wire attacked is what is known to the electric light engineers as a distributing wire, and its severance cut off all the lights on Broadway to Forty-second street.

The electric light company officials were wild when they discovered what had been done, and asserted that private customers were injured, and, it is said, planned to mend the cut in the wire secretly. If they succeeded the Subway would have to sue the company and secure an injunction before the use of the distributing wire could be prevented.

A policeman has been on guard at the Thirty-third street corner ever since, with orders to see that no one tampers with the cut wire. Commissioner Moss passed the corner at 3 o'clock yesterday afternoon.

"Are you watching that wire, officer?" he said. "That's right. See that no one touches it."

The Subway board wants to force the company using the elevated wires at this point to bury its wires in the subway, and the company objects because of the expense. One company has given up the fight, and has buried its wires wherever the subway channel has been laid. The air lines of this particular company in other parts of the town have not been disturbed in the general onslaught of the past few days.

Court of Patent Appeals.

The committee on the judiciary of the house of representatives reported favorably on the bill for establishing a Court of Patent Appeals, promulgated by the National Electric Light association [WESTERN ELECTRICIAN, p. 312, vol. II, issue of June 23, 1888], and September 12th the bill was committed to the committee of the whole. The amendments of the committee are found in the subjoined:

"The Court of Patent Appeals, as provided for by the bill and amendments reported by the committee, consists of one chief justice and two associate justices, who shall be appointed by the president, by and with the advice and consent of the senate, and who shall hold office during good behavior, and receive a salary each of $6,000 per annum. The associate justices shall take precedence according to the dates of their commission, or, when the date of the commissions may be the same, according to age. The bill provides for the appointment of a clerk, deputy clerks, marshal, and reporter by the court. The fees of the clerk shall be the same as now allowed by law to the clerk of the Supreme court, but shall not exceed $6,000 a year. The salary of the marshal is fixed at $2,000 per annum. The pay of the reporter is not to exceed $2,500 annually, unless the number of reports required to be printed shall be increased by order of the court, in which case the salary or pay may be increased not exceeding $1,500 a year. The court is required to hold one term annually at the seat of government, commencing on the second Monday in October, and may hold special or adjourned terms as the court may deem proper for the dispatch of business."

The general recommendations of the committee are appended:

"The expediency and propriety of, if not necessity for the establishment of, such a court as contemplated by this measure will not be questioned if proper consideration be given to the objects that will be attained by the passage of this bill.

"Among the results reasonably expected to flow from the organization of a Court of Patent Appeals, attention may be called to the following: 1. It would enable the public and patentees to determine the value and validity of patents without serious and vexatious delays, and thus promote the interests of all concerned. 2. It will relieve the Supreme court of much of the burden imposed upon it by this class of litigation. 3. The practice in the Patent office would become thoroughly fixed and understood, and, as a consequence, the issue of worthless patents, in which unscrupulous persons deal to the injury of the public, would be greatly diminished, if not entirely suppressed. 4. It would tend to simplifying the patent laws by constriction and settling questions of doubt, which are often used by litigants for the purpose of injustice and oppression.

"Without intending to present the reasons at length which induce your committee to arrive at the foregoing conclusions, the following observations are submitted: The life of a patent, at most, is seventeen years, and if it is a valuable one, or intricate and radical, it usually requires one-fourth of that period to introduce it and secure its use by the public. This, in part, results from the fact that manufacturers who must be relied upon to make and introduce new inventions are slow and reluctant to place in general use inventions which displace or render valueless articles in the production of which they are already engaged. This is illustrated by experts, who say that to change from one style of gun to another requires from $1,000 to $2,000, and from six months to a year's time to make the model gun from which to make the dies, gauges, special tools, etc., and that to make these latter much time and money are required. When ordinarily the financial life of a patent is abridged by the difficulties of placing the invention into general use, we can appreciate the importance of speedy decisions when it is infringed, or when its validity is questioned.

"Under the present condition of the business of the courts it requires, ordinarily, from two to three years to obtain a decision in the Circuit court of the United States, and if appealed to the Supreme court from three to four years are required to obtain a decision. It may be said that the same difficulty and delay attend the determination of all other questions involving the determination of property rights. While this is true, it should be borne in mind that this species or character of property differs from all other kinds of property. The duration of the owner's title is arbitrarily fixed by law. The period is short, for the most part, seventeen years.

"The constitution imposes upon congress the duty of securing to authors and inventors, for a limited time, the exclusive right to their respective writings and inventions. It is submitted, respectfully, that this duty is very imperfectly discharged when, by the omission of congress to provide proper means to determine questions arising out of patents, the life of a patent may be frittered away by the delays of the law.

"As has been said, it requires from three to four years after a cause is filed in the Supreme court to obtain a decision. This does not result from any fault of the judges. It is due solely to the fact that congress has so broadened the appellate jurisdiction of the court as to overburden the physical capacity of the tribunal. The original jurisdiction of the court, fortunately, is fixed by the constitution, and congress cannot add to it or subtract from it, but the appellate jurisdiction of the court is subject to the power of congress, and that authority has been exercised without proper regard to the physical capacity of the judges or the interests of litigants. This condition ought not to be continued. It operates in a great many cases as a denial of justice, and every citizen of the United States is interested in bringing about a change.

"It may be asked how this measure will contribute to that result? To that inquiry it may be answered that by the sixteenth section of the bill, it is provided that appeals from the court proposed to be established to the Supreme court shall be subject to the same regulations as now exist with regard to appeals to the Supreme court in causes of admiralty and maritime jurisdiction, and to such further regulations as the Supreme court may make. By reference to the act of 1875, relating to the practice in the courts of the United States in cases of admiralty upon appeals to the Supreme court and the rule of the Supreme court upon that subject, it will be observed that the Circuit court is required to make a finding of facts and law, and the review of the judgments of the Circuit courts by the Supreme court in these cases is confined to questions of law only. It follows that if a similar rule shall be applied to patent cases, as the sixteenth section of the act provides, the Supreme court, in reviewing the judgments of the court proposed to be established, will pass upon questions of law only, and thus from 15 to 20 per cent. of the time now consumed by the court in these cases, in wading through voluminous records endeavoring to find the facts, will be saved and profitably applied to the disposition of other business in the court. It is difficult to perceive any good reason for requiring the Supreme court to find the facts in patent cases and not in admiralty cases.

"Upon the score of economy it is respectfully submitted that the expenses of this court will not exceed $30,000 per annum. Such a sum of money bears no comparison to the amount that will be saved to the people of the United States by the speedy adjudication of questions arising out of patents. To this should be added also the incalculable advantage that will result to litigants in the Supreme court of the United States from the saving of time. The income of the Patent office for the fiscal year ending June 30, 1888, was $1,122,994.88; expenses, $953,730.14; leaving a surplus turned into the treasury of the United States of $169,264.49, which, added to the previously credited surplus, makes a balance in the treasury to the credit of the patent fund of $3,337,666.65."

Petroleum Fuel.

Editor WESTERN ELECTRICIAN:

MINNEAPOLIS, Minn., Sept. 24.—I desire to correct an error in my paper on petroleum fuel, published in the WESTERN ELECTRICIAN of Sept. 8, and which was made by me in copying the figures. It is this: 111.34 horse power running *six* hours, etc., should read 111.34 horse power running *seven* hours, etc. I think with this correction the remainder of my figures will be found correct. Yours very truly,

S. S. LEONARD.

Phonographic Facts.

It is reported that at the fifth annual reunion of the Hartwell family, which took place at Concord last week, a phonograph recorded the various speeches, so that they may be repeated at future reunions.

The following interview may set at rest the fears of some stenographers. An electrical man says: "Don't you fear that the phonograph is going to supersede the lady stenographer. Why? Did the bicycle drive out the horse? The bicycle can carry you wherever you want to go, but the horse is still with us. The ladies, I tell you, have come to stay. I have two stenographers, and they are not the very prettiest ones either. Now, I had a phonograph in my office for weeks, but did I discharge the ladies? No, and I don't mean to either. It is just here; they can do what the best trained phonograph never can do. There is a large part of my correspondence I can hand over to one of them and never give a second look at it, because she can answer the letters as well as I can. No matter how near and dear your phonograph is to you, it can never do that. Moreover, I can say, 'I am going out of the office for awhile; I wish you'd look after things.' Now, the best trained phonograph, if I put a collar and tie on it, couldn't do that. No, don't make any mistakes. No machinery ever has succeeded or ever will in distancing the human race."

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THE NUMBER.

	PAGE
The Silvey Dynamo, Illustrated	179
Electric Road at Alliance, O	179
German Electrical Field	179
Pulsatory Current System, Illustrated	180
Pullman Electric Road	180
Chicago Electric Club	180
Galvanic Batteries, by C. H. Rudd, Illustrated	181
Women as Telegraphers	181
New Form of Law Battery, Illustrated	182
Telephone Lines and Heavy Electric Currents	182
Alternating Work of the Fort Wayne Jenney Company	182
Electric Lights in the Lumber Business	182
New Electric Postal Road at Baltimore	183
An Automatic Torch, Illustrated	183
War on Aerial Wires in New York	183
Court of Patent Appeals	183
Petroleum Fuel; Communication by S. S. Leonard	183
Editorial	184
British Association	185, 186
Lamp Lighting Schedule—Moonlight System, October	187

DEPARTMENTS.

Correspondence	186, 187
The Electric Light	187, 188
The Electric Motor	188
The Telephone	188, 189
The Telegraph	189
Electrical Patents	190

THE electric light is always popular. At the St. Louis exposition the crowd about the waterfall electric light piece is so great that pickpockets have made it their headquarters, and the management has been advised to put a sign at that point warning visitors to "Keep your hands on your pocketbooks."

THE attractiveness of the corn palace at Sioux Falls, Ia., is enhanced greatly by electric light. A correspondent says: "The interior of the palace is veritably a realm of enchantment. Under the brightness shed by half a hundred electric lights after nightfall, it presents an appearance that rivals fairyland."

SEVERAL men and boys who were imprisoned in a burning building on Lake street, Chicago, last week, owe their escape from death to a line of telegraph and telephone wires. They jumped from windows and clung to the wires until rescued. There is nothing remarkable in the case, but it is an imperative duty to speak a good word for the much maligned overhead wires whenever it is possible.

AN experimental road near Baltimore for the rapid transmission of postal matter is well under way. The road is referred to elsewhere, and the system was described in a previous issue. If the road proves as successful as the outlook promises, it naturally follows that there will be a quick and great demand for it. The postal authorities and the railroad companies have combined to reduce the time of transmission of letters between important cities to the lowest possible limit, but if the anticipated speed of transmission by the electric system—five miles a minute—or even only one-fifth of it is realized in practice, the speed attained by steam will scarcely bear comparison. Here seems to be another instance of evolution and revolution.

A VALUED correspondent sends us the appended suggestion. It is given place in this column in order that it may have a chance for expansion:

"Germans are original, linguistic, and scrupulously exact in having their words describe every shade of meaning and every peculiarity of the thing to which a name is applied. Here is a word which is suggested for the multiple switch-board for use in Germany—*Deutscher Fernsprechvielfach Klappenschrank.*"

THE committee on mechanical nomenclature, at the Bath meeting of the British Association for the Promotion of Science, suggested the use of the following terms:

1 cm. per sec. =1 kine.
1 gramme kine =1 bole.
1 dyne per sq. cm. =1 barad.

The committee on electrical standards recommended the adoption of the term "therm" as the amount of heat required to raise one gramme of pure water one degree centigrade at the temperature of maximum density, and "Joule" as the work done by a watt per second.

THE Chicago Electric club held its first fall meeting last Monday evening, and the organization is now prepared for active work. President Barton was in the chair, and in three or four timely little speeches indicated his hearty belief in an aggressive policy. He has taken a strong interest in the club. He believes the time has arrived when a club house should be secured, and that its social features should be on a par with its literary character. President Barton is Chicagoan enough to desire mightily that the western metropolis should not be outdone in any respect by an eastern city. He urges that vigorous measures be taken to increase the membership and to provide suitable quarters. The outlook for the club under Mr. Barton's leadership is flattering.

MR. RUDD in his article on galvanic batteries recognizes the very great absorption of electricians in the mechanical generation of electricity, but very truly says there is room for good work in studying that servant of other days, the galvanic battery. Mechanically generated electricity has its field, and chemically generated electricity its field; neither can usurp the whole. Therefore, as long as man lives, there will be a place for the galvanic battery. Day by day we are acquiring fresh knowledge of mechanically generated electricity while, generally speaking, our knowledge of the galvanic battery is at a standstill. But there is still much to learn, and quite probably investigations such as Mr. Rudd has undertaken, will bring forth new facts of great value. The diagrams presented with the paper in question are very interesting in the showing they make of the drop and the recovery of the e. m. f. during the tests.

THERE are printed in this issue synopses of several papers read at the annual meeting of the British Association for the Promotion of Science. Whoever examines the proceedings will be struck by the gratifying fact that the results of American experience are so often alluded to. The English with confidence assert their claim to superior knowledge in the electrical field, but when it is a question of practice they yield the palm to the enterprising Yankee. The concession is not always gracefully made; it is frequently made in bitterness of spirit, but the fact remains, and it is admitted. Several speakers paid their respects to the English "iniquitous" electric light act and cited it as a cause of the backwardness of the art in England. In Mr. Preece's paper a curious illustration of the advantages of electric light from an economical standpoint, is given. In a London bank the sickness of the employes has been greatly reduced since the better illuminant has been used. The saving by the avoidance of absence alone has been over $1,000. Mr. Preece also took occasion to express his disapproval of electric executions.

THE Michigan senate has entered upon an investigation into the methods of business of the French syndicate, otherwise known as the copper trust, and its action is exciting considerable indignation among copper mine owners in that state, as they look upon the investigation as a piece of unwarrantable interference.

The history of the copper trust, however, may be given in a few words: The selling price of lake copper, which is now what it was five years ago, decreased steadily from 1883, until in the summer and early fall of last year it was being sold at 10 cents per pound, and one large sale was made at 9⅞ cents. At this time the French *Societe des Metaux* was formed to corner the copper product of the world. The syndicate secured an almost unlimited backing of capital in Paris and London, and set to work quietly buying the copper production of the coming two years of all mines of any importance at 13 cents a pound, with a promise of half the profits, it is said. The mines sold, and just after the bargain was completed the big fire occurred in the Calumet and Hecla mine, the principal copper producer of the world. This fire would have sent the price of copper to 11 or 12 cents a pound, but the syndicate sent the price up to 16½, 17, and even 19 cents a pound. Sixteen and a half cents is the price set by the syndicate. As the mines sell at 13 cents, the syndicate has a profit of 3½ cents a pound. Half of this is given to the mine owners and half goes into the pockets of the members of the *Societe des Metaux*.

The United States senate committee on finance also began last week an inquiry into the operations of the copper syndicate. Charles H. Pine of Ansonia, Conn., treasurer of the Parrot Silver & Copper Mining company, testified that his company had a contract with the *societe* which ostensibly limited the production of his mine to a certain amount of copper, but in reality the limit was placed beyond the present possibility of production. He sold the copper on behalf of the *societe*, the company realizing 13 cents a pound and one-half of the profits above that sum, the other half of the excess over the 13 cents going to the *societe*. He was also authorized to sell at all times at ¼ of a cent a pound less than the price of lake copper.

John Stanton of New York, treasurer of three lake copper mining companies, was a witness. He stated substantially the same facts in reference to the contract with the syndicate. He explained that the *societe* took all the surplus copper produced in America and sold it abroad, paying the American companies one-half of the sum realized above 13 cents a pound, and making the deficit good when the price realized was less than 13 cents, whether sold at home or abroad. The *societe* had the right at all times to fix the price of sale. The *societe* had contracts, witness understood, with practically all the mines in the country. He declared emphatically in favor of a protective tariff, and said without it the mines of Lake Superior, Arizona or Montana, could not have been developed. The protection afforded by the tariff, he said, had made the United States the largest copper producing country in the world.

Charles Rahl of New York, who was called as a witness, testified that, while he was an independent operator, practically he sold for the *societe*. Consumers who purchased copper of the syndicate, were required to agree not to put the copper on the market again, but consume it in their own works. He did not understand that the *societe* had a monopoly of copper manufacture in France, although it controlled some twenty or thirty mills in different parts of the country. No copper had been imported into this country for several years, though the tariff had nothing to do with its exclusion. The United States had become the largest producer of copper, and produced it considerably in excess of our possible consumption.

The witnesses all agreed that there were no American members of the *societe;* also in the statement that the price of copper to the consumer to-day is less than the average for the last ten years.

British Association.

The British association for the Promotion of Science held its annual meetings in Bath, England, the first week in September. The attendance was large, and the papers read before all the sections were of a high scientific character, yet many of them were exceedingly practical. It is said that in late years the British association has shaken itself free from a mild contempt of practical papers, and welcomes them with the same readiness as the most advanced researches in pure science. The president, Sir Frederick Bramwell, in his opening address, took a rapid survey of the development of engineering. In speaking of the electrical field he said: "In this country, no doubt, still more would have been done if the lighting of districts from a central source of electricity had not been, since 1882, practically forbidden by the act passed in that year. This act had in its title the facetious statement that it was 'to facilitate electrical lighting,' although it is an act which, even modified as it has been this year, is still a great discouragement to free enterprise, and a bar to progress. The other day a member of the house of commons was saying to me: 'I think it is very much to our discredit in England that we should have allowed ourselves to be outrun in the distribution of electric lighting to houses by the inhabitants of the United States and by those of other countries.' I will merely, and as illustrative of my views of the value of the application of science to science itself, say there is no branch of physics pursued with more zeal and with more happy results than that of electricity, with its allies, and there is no branch of science toward which the public looks with greater hope of practical benefits."

W. H. Preece followed with a paper devoted to the practical applications of electricity. He spoke of lightning conductors in this way: "As long as points remain points, as long as conductors remain conductors, as long as the rods make proper connection with the earth, lightning protectors will protect; but if points are allowed to be fused or to corrode away; as long as bad joints or faulty connections are allowed to remain; as long as bad earths or no earths exist, so long will protectors cease to protect, and they will become absolute sources of danger. Lightning conductors, if properly erected, duly maintained and periodically inspected, are an absolute source of safety; but if erected by the village blacksmith, maintained by the economical church warden, and never inspected at all, a loud report will some day be heard, and the beautiful steeple will convert the churchyard into a new geological formation."

Mr. Preece spoke of the development of telegraphy. He mentioned these facts: "The quantity of news transmitted is enormous; an average of 1,538,270 words are delivered per day. The recent convention in Chicago, when the republican party of the United States nominated their candidate for the presidentship, created so much business that every American paper has chronicled this big thing as unique; 500,000 words were sent on one night; but we in England, when Mr. Gladstone introduced his celebrated Home Rule bill on April 8, 1886, sent from the Central telegraph office in London 1,500,000 words."

Of the telephone he said: "At the meeting of the association in Plymouth, in 1877, I was able for the first time in this country to show the telephone at work. Since then its use has advanced with giant strides. There are probably a million instruments at work now throughout the civilized world. Its development has been regularly chronicled at our meetings. As far as the receiving part of the apparatus is concerned, it remains precisely the same as that which I brought over from America in 1877; but the transmitter, ever since the discovery of the microphone by Hughes in 1878, has been entirely remodeled. Edison's carbon transmitter was a great step in advance, but the modern transmitters of Moseley, Berliner, D'Arsonval, De Jongh, leave little to be desired. The disturbances due to induction have been entirely eliminated, and the laws regulating the distance to which speech is possible are so well known that the specification of the circuit required to connect the Land's End with John O'Groat's by telephone is a simple question of calculation. A circuit has been erected between Paris and Marseilles, 600 miles apart, with two copper wires of 6½ gauge, weighing 540 pounds per mile, and conversation is easily maintained between those important cities at the cost of three francs for three minutes. One scarcely knows which fact is the more astounding—the distance at which the human voice can be reproduced, or the ridiculously simple apparatus that performs the reproduction. But more marvelous than either is the extreme sensitiveness of the instrument itself, for the energy contained in one heat unit (gramme water degree) would, according to Pellat, maintain a continuous sound for 10,000 years."

Of the economy of the electric light, Mr. Preece gave this curious illustration: "In our Central Savings bank in London it has been found, after two years' experience of electric lighting, that the average amount of absences from illness has been diminished by about two days a year for each person on the staff. This is equivalent to a gain to the service of the time of about eight clerks in that department alone. Taking the cost at the 'overtime' rate only, this would mean a saving in salaries of about £640 a year. The cost of the installation of the electric light was £3,349, and the annual cost of working £700 per annum—say a total annual cost of £1,034. The cost of the gas consumed for lighting purposes was about £700 a year, so that on the whole there was a direct saving of something like £266 a year to the government, besides the material advantage of the better work of the staff resulting from the improved atmospheric conditions under which their work is done." Of the improvement in plants he said: "The glow lamp of Edison, which in 1881 required 5 watts per candle, has been so far improved that it now consumes but 2¼ watts per candle. The dynamo, which in the same year weighed 50,000 pounds, absorbed 150 horse power, and cost £4,000 for 1,000 lamps, now weighs 14,000 pounds, absorbs 110 horse power, and costs £500 for the same production of external energy; in other words, its commercial output has been increased nearly six times, while its prime cost has been diminished eight times."

Mr. Preece spoke somewhat at length of the electric motor, and predicted great improvements in it. Of the general purposes to which electricity is applied he said: "Every one appreciates the silent efficiency of the trembling electric bell, while all will sooner or later derive comfort from the perennially self-winding electric clock. Correct mean time is distributed throughout the length and breadth of the land by currents derived from Greenwich observatory. Warehouses and shops are fitted with automatic contact pieces, which, on any undue increase of temperature due to fire, create an alarm in the nearest fire station; and at the corner of most streets a post is found with a face of glass, which, on being broken, enables the passerby or the watchful and active policeman to call a fire engine to the exact spot of danger. Our sewers are likely to find in its active chemical agency a power to neutralize offensive gases, and to purify poisonous and dangerous fluids. The germs of disease are attacked and destroyed in their very lairs. The physician and the surgeon trust to it to alleviate pain, to cure disease, to effect organic changes beyond the reach of drugs. The photographer finds in the brilliant rays of the arc lamp a miniature sun which enables him to pursue his lucrative business at night, or during the dark and dismal hours of a black November fog of London."

His disbelief in electric executions was manifested by this remark: "Those who have assisted at this hasty legislation would have done well to have assured themselves of the practical efficacy of the proposed process. I have seen the difficulty of killing even a rabbit with the most powerful induction coil ever made, and I know those who escaped and recovered from the stroke of a lightning discharge."

Prof. G. F. Fitzgerald addressed one of the sections on the hypothesis that electro magnetic phenomena take place by means of an intervening medium. He said: "The year 1888 will be ever memorable as the year in which this great question has been experimentally decided by Hertz, in Germany, and I hope by others in England. It has been decided in favor of the hypothesis that these actions take place by means of an intervening medium. * * * There were two hypotheses as to the causes of electro magnetic action. One attributed electric attraction to a property of a thing called electricity, to attract at a distance; the other attributed it to a pull exerted by means of the ether, somewhat in the way that air pushes balloons up. We do not know what the structure of the ether is by means of which it can pull, but neither do we know what the structure of a piece of India rubber is by means of which it can pull, and we might as well ignore the India rubber, though we know a lot about the laws of its action, because we do not know its structure, as to ignore the ether because we do not know its structure. Any way, what was wanted was an experiment to decide between the hypothesis of direct action at a distance and of action by means of a medium."

The experiments of Hertz were explained as follows: "By a beautiful device Hertz has produced rapidly alternating currents of such frequency that their wave length is only about two meters. I may pause for a minute to call your attention to what that means. These waves are propagated 300,000 kilometers in a second. If they vibrated 300,000 times a second the waves would be each a kilometer long. This rate of vibration is much higher than the highest audible note, and yet the waves are much too long to be manageable. We want a vibration about a thousand times as fast again, with waves about a meter long. Hertz produced such vibrations, vibrating more than a hundred million times a second. And how did he detect the vibrations and their interference? He could not see them; they are much too slow for that; they should go about a million times as fast again to be visible. He could not hear them; they are much too quick for that. If they went a million times more slowly they would be well heard. He made use of the principle of resonance. He constructed a circuit whose period of vibration for electric currents was the same as that of his generating vibrator, and he was able to see sparks, due to the induced vibration, leaping across a small air space in this resonant circuit. The well-timed electrical impulses broke down the air resistance. By its means Hertz has been able to observe the interference between waves incident on a wall and the reflected waves." He placed his generating vibrator several wave lengths away from a wall, and placed the receiving resonant circuit between the generator and the wall, and in this air space he was able to observe that at some points there were hardly any induced sparks, but at other and greater distances from his generator they reappeared to disappear again in regular succession at equal intervals between his generator and the wall. It is exactly the same phenomenon as what are known as Lloyd's bands in optics, which are due to the interference between a direct and a reflected wave. It follows hence that just as Young's and Fresnell's researches on the 'Interference of Light' prove the undulatory theory of optics, so Hertz's experiment proves the ethereal theory of electro magnetism. It is a splendid result. * * * We seem to be approaching a theory as to the structure of the ether. There are difficulties from diffusion in the simple theory that it is a fluid full of motion, a sort of vortex sponge. There were similar difficulties in the wave theory of light owing to wave propagation round corners, and there is as great a difficulty in the jelly theory of the ether arising from the freedom of motion of matter through it. It may be found that there is diffusion, or it may be found that there are polarized distributions of fluid kinetic energy which are not unstable when the surfaces are fixed; more than one such is known."

Professor Forbes read a paper on electric lighting in America. He spoke of the marvelous extension of electric lighting in America, not merely in cities but in small out-of-the-way places, in the most distant states. He said it was estimated in February of last year the 300,000 arc lights and 2,225,000 incandescent lamps were in use in the United States. Four or five manufactories were capable of turning out 10,000 incandescent lamps each daily. He continued: "It has been said that in this country we do not go ahead so much as they do in America, and various reasons have been suggested to account for this. Professor Ayrton's most admirable reason seems to go a long way—namely, that there are two definitions of inertia, the English, which is, that inertia is a resistance to motion and the American, that it is a resistance to stopping. But I must say that in electric lighting we certainly have been stopped a great deal by what I might almost call the iniquitous electric lighting act And I regret extremely, in the interests of the public and of electric lighting generally, that an act has been passed this year which has not yet put electricity on the same footing as gas. This is a matter for extreme regret to all those who have the ultimate benefit of the electric lighting industry at heart, for that act will delay the due recognition of the value of electric lighting. But I must say that I do not think the electric lighting act is the only thing which has delayed our progress, because I see that in electric traction and other developments of electricity also the Americans have gone ahead with great energy, and I certainly do not put it down to want of capacity on the part of our inventors, for I find that the best dynamo machines are all designed originally in England, and the best arc lamps there are are to be found in England; but with inferior machines and lamps in the states, I have noticed that they are determined, as long as they have something which they know will work well, to make it work, and be ready in the meanwhile to take up something else. I think, therefore, that it is not in the inventors that we have to look for, goaheadedness, but to men of capital who are technically instructed. I think it is technical instruction among the money classes that has developed electrical engineering so much in America of late years" Professor Forbes followed with a somewhat minute description of Westinghouse central stations.

R. Percy Sellon's paper related to "Electric light applied to night navigation on the Suez canal" In the year following the opening of the canal, 1870, 496 vessels availed themselves of this new route to the east. In 1885 the number reached 3,624. Delays were caused by the active traffic. The narrowness of the channel made it impossible for ships to pass each other, except at the "tying up" points which are located five miles apart. Vessels were obliged to "tie up" when ships came from the opposite directions. In 1885 the average time of making the passage of 87 miles was 43 hours. Navigation at that time was only possible by day. In 1885 it was decided to allow vessels of war and mailships to pass through if equipped with electric light, and in 1886 the authorization was extended to all vessels. The regulations of the company require that an electric search light throwing a beam of 1,200 meters and a lamp and reflector lighting a circular area of 200 meters in diameter, must be provided. The first-class steamers which are lighted by incandescent lamps usually carry with them as part of their equipment the necessary apparatus for navigating the canal by night Other vessels can hire portable plants at either entrance. In May, 1888, 43 per cent. of the vessels employed the electric lights in passing through the canal. By the use of the light, vessels can reduce the time of the passage, nearly 24 hours. For vessels of 2,500 tons this would mean a saving of $150 to $200. The saving for a first-class passenger steamer would be from $500 to $750. In round numbers the saving to maritime commerce would be $500,000 annually.

Henry Edmunds described his system of electrical distribution which is now employed in actual practice in London. He said: "A number of groups of cells, which we will call the local batteries, are placed at different points or centers where supply is required in the district, each battery having its individual number of cells according to the voltage required locally, and the amount of current to be supplied. These local batteries are electrically distinct and independent of each other and of the charging main, neither is there a duplicate set to be changed, but instead we employ an additional group with each of the local batteries, which we will term the main batteries, the number of cells of which are a divisor of the number employed locally—generally one-third. For example, suppose the local voltage be 48 volts, 32 cells would be employed which we would subdivide into 4 groups, 8 cells in each, and for purposes of identification we will call these groups a, b, c, and d respectively. Groups b, c and d are connected in series in the local, giving 48 volts. Group a, being in the main, being charged for a limited period of time—in practice 2 minutes—is then removed from the main charging circuit and placed in the local discharging circuit, when say group b is removed from the local into the main to be charged; b now in turn exchanges places with c and c with d, so that each group a, b, c, d, follow each other in turn from the main to the local or local to main, whereby in every 8 minutes each group has received its increment of charge from the main and has supplied the same in turn to the local, and so on continuously, until in 24 hours each group has received its full charge of current, enabling the battery to maintain its maximum discharge for eight hours, the current employed in practice being 70 amperes, and the size of cells proportionate. Incidentally, we find many advantages due to charging cells in this manner We can maintain a constant potential on the local circuit, so that we have not the interference and fluctuation due to charging and discharging at the same time. The high tension main is never at any time in electrical contact with the local circuit, thereby freeing the system from leakage to earth and its attendant danger. Also the cells are kept in much better condition by continually receiving short increments of charge and having periods of rest from discharge. The loss due to difference of potential between the charging and discharging current is minimized, it being found in practice we can continue charging the cell to its maximum capacity with a mean voltage of 2.25, instead of 2.5 per cell as is required, where cells are charged continuously. This, on a large scale, is a considerable element of economy, where there are a number of cells in the charging main. Also we find that an approximately constant potential on the local circuit enables us to run lamps at a higher efficiency, without the risk of rupture due to sudden rises of pressure; and so far as we can judge the life of the batteries is considerably lengthened by this mode of intermittent charge and

rest. And in addition to all these advantages we have a great saving in the generating station in cost of plant, only one-third of the power being required to operate the same number of lights for eight hours, that would be necessary for any direct system, and much less electric force or pressure on the charging mains to supply the same number of lamps, thereby saving cost of installation, and chance of leakage. The additional advantage of being able to run a smaller station for 24 hours in the day is obvious, as we do not have any idle plant with interest thereon. * * * Such a system as I have briefly described lends itself to many purposes in connection with electricity supply. For instance, in the working of railroad switches and signals, electrically, a distribution at each block station would enable a whole line of rail, say 200 miles, to be supplied from one source, the pressure on the main being only a small fraction of the sum of the local pressure; or in electric tramway work, a charged main, well insulated, of high pressure, could supply a number of points en route which in turn could each, independently of the other, supply large volume low pressure currents locally—saving risk of breakdown and consequent interruption of traffic. But more particularly is it useful in detached house and suburban lighting, for it solves the problem of giving each house its own individual supply of electricity continuously day and night, totally independent of continuous or regular working at the central station, or of interference from other work on the same circuit, being at the same time absolutely safe from the danger of shock, and above all, supplying the electric light at a reasonable cost."

Nicholas Watts read a paper on "Miners' Electric Safety Lamps." He thought the question, which is the most suitable battery for miners' lamps, though keenly debated, had not yet been finally settled. The secondary battery was doubtless, more durable, but where dynamos were not already employed the primary battery would find favor.

These lamps were described:

"*The Swan Lamp.*—Secondary battery. The elements, lead and lead oxide, are cylindrical, and are arranged concentrically in each cell. They are contained in a block of gutta-percha, with four cell compartments inclosed in a wooden case. The exciting liquid is dilute sulphuric acid. The cells are recharged by placing the lamp on a stand connected to a dynamo. The lamp proper is attached to the side of the case, and is protected by a 'bull's eye' of thick glass. A light of from one to 1½ candle power is given for a period of ten hours. The weight is 7lbs and the cost of maintenance is 3½d. per week. Several hundreds of these lamps are now in use at Kisca and elsewhere, and the writer is informed that they give satisfaction.

"*The Walker Lamp.*—Primary battery. Bichromate-carbon-zinc battery, the carbon being itself the containing vessel. On one side is a strong lens faced by a parabolic reflector, the two being held by a strong brass cylinder attached to the outer case, which is also of brass or copper. The lamp is made in two sizes, of which the smaller weighs 5lbs. The battery is composed of two carbon-zinc cells. The liquid used is a mixture of bichromate of potash, nitric acid, and plain sulphuric acid. The e. m. f. is 4 volts, and the current 0.3 of an ampere. The price is from 30s. to 25s. The light afforded by the small lamp is sufficient to enable ordinary newspaper print to be read at a distance of 6 feet from the lamp for 10 hours. The battery of the larger lamp, which weighs 7 pounds, has three carbon-zinc cells. The e. m. f. is six volts, and the current 0.5 of an ampere; price, 48s., 35s , and 32s. respectively. The cost of renewing the chemicals used, the incandescent lamp and incidental repairs, is stated to be not more than ¾d. per day for the small, and 1d. per day for the large lamp. The cost of the liquid has been frequently tested, and has come out at 1½d. per day of twelve hours' run. The operation of renewing, which is effected in a few minutes, consists in running off the liquid and washing out the cells, running in fresh liquid, and replacing the cover, by which last act the connections between the battery and the lamp are made.

"*The Pitkin Lamp.*—Secondary battery of four cells. The weight of this lamp is 8 pounds, and the price £2 2s. Illuminating power, four to five candles; a reflector is employed to concentrate the light. The battery is composed of four cells, each having eight plates or fingers, the elements being peroxide of lead and spongy lead. The battery takes eight hours to charge. Mr. Pitkin estimates the life of the battery at about two years; e. m. f., eight volts; current, .4 of an ampere. The Pitkin lamp is furnished with a switch, and a resistance to regulate the expenditure of the e. m. f., which, if allowed to act without check, would, when the battery was started, destroy the filament W. W. Hood, Llwynypia tried fifty Pitkin lamps, and found that the switch was a difficulty. The men, unless very careful, put on the switch too full, and broke the filament.

"*The Schanschieff Lamp.*—Primary battery. The exciting liquid employed is a solution of basic sulphate of mercury in the acid sulphate, one part of the salt being entirely dissolved in three parts of water, according to Schanschieff's patent. The battery can be charged in fifteen seconds. The elements are zinc and carbon; a single liquid only is employed, and no porous cells, producing resistance and causing waste of energy, are required. The weight, with a battery of four cells, is 4½ pounds. Each cell takes five fluid ounces of the mercurial solution. The light ranges from 1½ to 2 candle power. The consumption of zinc is 1-12 pounds per shift, or ½ pound, for 48 hours (six shifts of eight hours). The liquid is supplied at 5s. a gallon, and is said to be worth, when spent, 4s. 3d., in consequence of the solid residue and free mercury precipitated by the action of the cells. The working cost of the 4-cell lamps for six shifts of eight hours is 5d., or ⅝d. for one shift. In some forms of the lamp the solution occupies a little less than half the height of each cell, and the elements occupy the other half or opposite end of the cells. Thus the lamp is capable of being put out of action by inverting it. The liquid is changed every eight hours. The price is 30s.

"*The New Portable Electric Lamp & Power Syndicate Company's Lamp.*—The battery is secondary, and consists of two cells, the elements being lithanode (peroxide of lead) and spongy lead. The weight of the lamp is 4½ pounds. The light given is one candle over a period of 10 to 12 hours. The battery takes five hours to charge, the cost of recharging being 3d. per week. The price is £1 1s The lamp is fitted with an automatic arrangement in connection with the incandescent lamp, whereby, if the outer casing of toughened glass be broken, the current is cut off, and explosion of fire-damp guarded against."

Prof Ayrton read an interesting paper on "Electric Transmission of Power." It is impossible here to give anything more than a few specimen bricks, which will, it is thought, give a general idea of the structure. The paper was detailed, and the writer made experiments which added to the interest. After speaking generally of the transmission of power, Prof. Ayrton said:

"In America there are 6,000 electro motors working machinery; in Great Britain hardly 100. But it is not only in transmitting the power from the steam, gas or water engine of a factory to the various machines working in it, that electricity can be utilized. An incredible amount of power is daily running to waste in this and other countries, because many of the rapid streams of water are too far away from towns for their power to have been hitherto utilized. If we take as a low estimate that a large, well-made steam engine burns only two pounds of coal per horse power per hour, the coal consumption, which would be equivalent to the waste of power at Niagara, would exceed 150,000,000 of tons per annum, which, at only 5s. or 6s. per ton, means some 40,000,000 pounds sterling wasted. The newspapers of last week contained a long account of the spiral electric mountain railway that has just been opened to carry people up the Burgenstock, near Lucerne, and worked by the River Aar, three miles away, so that we see electric traction worked by distant water power is extending. But splendid as are these most successful uses of water power to actuate distant electro motors, it is but a stray stream here and there that has yet been utilized, and countless wealth is still being squandered in all the torrents all over the world. There are four methods of transmitting power to a distance: 1. By a moving rope. 2. By air compressed or rarefied at one end of a pipe operating an air motor at the other end 3. By water forced through a pipe working a water motor. 4. By electricity."

Prof. Ayrton discussed these modes of transmission, and enumerated the advantages of electric means, as follows:

"1. Economy in consumption of fuel.

"2. More perfect control over each individual machine.

"3. Ability to bring the tool to the work instead of the work to the tool.

"4. In greater cleanliness, no small benefit in this dirty, smoky age.

"5. And, lastly, there is still one more advantage possessed by this electric method of transmitting power that no other method can lay claim to—the power which during the daytime may be mainly used for driving machinery can, in the easiest possible way, be used during the night for driving light.

"In the electric transmission how does this power travel? Well, we do not know; it may go through the wires or through the space outside them. But although we are really quite in the dark as to the mechanism by means of which the electric power is transmitted, one thing we do know from experience, and that is this—given any arrangement of familiar electrical combinations, then we can foretell the result. Electricity is no more a source of power than a bell wire is; electricity is a marvelously convenient agent for conveying a push or a pull to a great distance; but it is not by the using up of the electricity that electric lights burn, or that electro motors revolve. It is by the electricity losing pressure, exactly as water loses head when turning the miller's wheel as it flows down hill, that work is done electrically."

Prof. Ayrton spoke of the expense of maintaining an electric battery, and said:

"As long as electro motors, as well as the machines for the production of electric currents, had this defect the electric transmission of power was like carrying coals to Newcastle in a leaky wagon. You would pay at least 16s. for your coal at Bath, lose most of them on the way, and sell any small portion that had not tumbled out of the wagon for—say 2s a ton, at Newcastle, a commercial speculation not to be recommended.

"A very great improvement in electric motors was made by Pacinotti, in 1860; but although his new form of electro motor was described in 1864 it attracted but little attention, probably because any form of electro motor, no matter how perfect, was commercially almost useless until some much more economical method of producing electric currents had been devised than the consumption of zinc and acids. Pacinotti, when describing his motor in 1864, pointed out that his principle was reversible, and that it might be used in a mechanical current generator. This idea was utilized by Gramme in 1870, who constructed the well-known Gramme dynamo for converting mechanical into electric power, a machine far more efficient than even Pacinotti had contemplated, and gave the whole subject of electrical engineering a vigorous forward impulse. Every subsequent maker of direct current dynamos, or motors, has followed Gramme's example in utilizing the principle devised by Pacinotti, which was as follows: In all the early forms of dynamos and motors there were a number of magnets and a number of coils of wire, the magnets moving relatively to the coils, or the coils relatively to the magnets, as you see in this rather old specimen of alternate current dynamo. To produce magnetism by a large number of little magnets is not economical, and Pacinotti's device consisted in arranging a number of coils around a ring in the way shown in the large wooden model, so that they could all be acted on by one large magnet. Instead of frittering away his magnetism, Pacinotti showed how it could be concentrated, and thus he led the way to dynamos and motors becoming commercial machines. Pacinotti's science, engineered by Gramme, not only made electric lighting commercially possible, but led to electricity being used as a valuable motive power. It was in their work that the electric transmission of power in its modern sense sprang into existence.

"Eighty-seven and a half per cent. of the power put into an Edison-Hopkinson dynamo has actually been given out by the motor spindle when 50 horse power was being transmitted. How does this compare with the *combined* efficiencies of an air pump and an air motor, or of a water pump and a water motor? I understand that in either of these cases 60 per cent. is considered a very satisfactory result. As far then as the terminal losses are concerned electric transmission of power is certainly superior to air or water transmission."

Electrical transformation might be effected," Prof. Ayrton said, by (1) alternate current transformers (2) motor dynamos (3) accumulators or secondary batteries, and (4) direct current transformers.

He spoke at length of the work which it was possible to accomplish by transformers. As an illustration an experiment in electric welding was given.

Coming to secondary batteries, Prof. Ayrton said:

"During the last few months fierce has been the battle raging among the electricians, the war cry being alternate current transformers *versus* accumulators, while the lookers-on, with that better view of the contest that they are proverbially said to possess, have decided that the battle is a drawn one. Neither system is the better under all circumstances; if the district to be lighted be a very scattered one use alternate current transformers by all means, but if the houses to be lighted are clustered together at a distance from the supply of power then the storing property possessed by accumulators, which enables the power of electric power to far exceed the capacity of the dynamos and engines in the busiest part of the twenty-four hours, will win the battle for accumulators. Any direct current system of distribution such as is furnished by accumulators has also the very great advantage that it lends itself to the use of the very efficient electro motors which I have been using this evening. Alternate current motors do exist, but they are still in the experimental stage, and are not yet articles of commerce. Secondary batteries have caused much heartburning for their uses from the apparent fickleness of their complex chemical action, yet but imperfectly understood. But we have at length been taught what is good and what is bad treatment for them, and after years of brave persevering application on the part of the Electrical Power Storage company, that forlorn hope, the secondary battery, has become one of the most useful tools of the electrical engineer."

Prof. Ayrton closed with descriptions of electric railways.

CORRESPONDENCE

New York Notes.

NEW YORK, September 29.—There has been a little breeze in connection with the removal of an abandoned telephone line on Sixth avenue by the department of public works. The men employed for that work are not electrical experts in any sense of the word, and their idea of preserving the continuity of circuits is rather crude. It so happened that in the course of their operations they severed one of the working wires of the United States Illuminating company which has no rights that the Board of Electrical Control feels bound to respect. The cutting of the wire in itself was of course no very serious matter, but Captain Reilly was instructed by Secretary Moss to station an officer at the corner of Thirty-third street with instructions to prevent any representatives of the electric light company from repairing the wire. Quite a number of the company's subscribers were thus deprived of their lights and a foundation laid for another lawsuit. The New York *Herald* has been publishing a few chapters of ancient history regarding the underground operations in this city, being incited thereto by its hatred for Jay Gould, believing that he in some manner is to be benefited by the prosperity of the conduit company, which it claims is controlled entirely by telephone interests.

Although the representatives of the prohibition party succeeded last week in obtaining from the board permission to erect a pole on Broadway from which to suspend a political banner, it was a short lived privilege, as a neighboring citizen made a complaint that the banner was a nuisance, and as its owners claimed that they had no desire to violate the law, it was removed by them before the mayor had a chance to work up another case against his colleagues for going out of their electrical jurisdiction.

There have been two accidents on the elevated roads within a week which go to prove that there is continual danger to be apprehended from those overhead structures, but they create no excitement as they are not enveloped in that veil of mystery which appears to accompany anything electrical. Steven Brodie who achieved notoriety by jumping off the Brooklyn bridge narrowly escaped being a victim of the first mishap, an iron brake shoe weighing fourteen pounds falling from a passing train, just grazing his person but sufficiently close to tear his clothing. Two or three days later one of the cylinder heads of a locomotive blew out, causing great alarm among the passengers, as well as people on the street. It is not probable that the dropping of heavy pieces of metal will kill or injure more than one person at a time, but the derailing of a train or the explosion of a boiler while passing a station may remind us that there

are some other things besides the overhead wires which need regulation.

A delegation of the board of aldermen has made a trip over the Fourth avenue line in the new electric car, which appeared to be satisfactory in every way, but not sufficiently convincing to the conservative guardians of the public interests to warrant them in saying that they considered it a success as a substitute for horses They appear perfectly willing, however, to grant a temporary permit with a view to proving the merits of electric traction.

An interesting decision has just been rendered by Justice Brown of the Supreme court in one of the numerous cases originating among the "ticker" companies which distribute quotations from the Stock exchange. The exchange authorities have always held that this information was private property, and their position is supported by Judge Brown, who says that no public duty rests upon the New York Stock exchange to make known the prices of securities dealt in by its members. "It is not," says he, "the outgrowth of any public demand, serves no public interest, has no special privileges or power, and has asked nor obtained nothing from the state except that protection which the law affords to every citizen, and exists solely for the purpose of affording its members facilities for the transaction of their individual business. * * * * The business is exclusively that of the individual members; and nothing, I take it, can be clearer than that the parties to a sale of property have an absolute right to keep the facts and details of that transaction to themselves, and deny any information relating thereto to all the world, and that there is no power in the courts under our constitution to compel them to make the same public."

Francis W. Jones, assistant general manager and electrician of the Postal Telegraph Cable company, is justly proud of his new dynamo plant for supplying current to the wires of that company. The basement of the building is fitted up with duplicate plants of dynamos, and engines supplied with steam from their own boilers, and also connected with the distributing pipes of the steam heating company. Heretofore it has been considered economical to substitute dynamos for batteries only in the very largest offices on account of the expense of operating a steam plant continuously. With the growth of the electric motor business, however, Mr. Jones is of the opinion that the practice will grow, provided sufficient pains is taken to make the motor service absolutely certain at all times. This he fears is only possible where the entire system is under one management. P.

Indianapolis Items.

INDIANAPOLIS, Ind., Sept. 27.—The city council's action, at the special session last Thursday night, in rushing through an ordinance, entitled "An ordinance to regulate incandescent lighting," is a little peculiar. Some weeks ago Mr. Briggs, of Terre Haute, came here, and after looking the ground over announced his intention to establish an incandescent electric lighting plant here, provided the city council would give him the necessary permission to put up poles and wires. No action seems to have been taken in the matter until last week, when the ordinance was rushed through. It says the company operating such incandescent plant shall put its wires under ground; shall not operate or furnish arc lights; must make semi-annual statements; pay the city a certain per cent. of earnings; give bonds for $25,000, and be under the direction of city engineer. The Fort Wayne Jenney company has had agents in the city for some time working up a business, and intending to establish an incandescent plant here. They are inclined to think the ordinance is a drive at them, but have not given up the idea of locating a plant here, and are continuing the canvass, hoping for some relief when the matter comes up before the board of aldermen. Mr. Briggs, who is at present out of the city, writes that he petitioned the council for a franchise in good faith, and, like the Jenney people, is inclined to think the ordinance is instigated by and in the interest of the gas company.

The Brush Electric Light company is taking down the four 90-feet towers erected by it three years ago, and which have never been used.

The McNeal Electrical Street railroad ordinance passed the council Monday night, with an amendment that the company must not use overhead conductors. Several ordinances were also introduced calling for electric lights in different parts of the city, in addition to the 100 already contracted for by the city. M.

Phoenix, Arizona.

PHOENIX, Ariz., Sept. 18.—The Phoenix Electric Lighting company has doubled its capital stock for the purpose of adding incandescent lights to its present arc light plant of the Brush system. The incandescent plant will consist of Brush alternating dynamos and Swan lamps. A Buckeye engine and boiler of 100 horse-power will also be installed, and when complete the plant as a whole will be one of the best in the western country. The plant was sold and will be put in operation by Bagnall & Hilles, who represent the Brush Electric company and the Buckeye Engine & Boiler company in Arizona and New Mexico. The electrician in charge will be A. L. Bagnall, the present superintendent and general manager. McC.

The Blue Grass Region.

HENDERSON, Ky., September 22.—A proposition was recently made to light this city by electricity. The council voted upon the matter three nights ago and rejected the proposition. Winchester, however, has taken a different action, and has decided that she will be lighted by electricity. Greenville, Tenn., has taken the same action. A.

Lamp Lighting Schedule. — Moonlight System.

OCTOBER.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	6.10	3.20	9.10
2	6.10	4.30	10.20
3	6.10	5.00	10.50
4	6.10	5.00	10.50
5	.10	5.00	10.50
6	6.00	5.00	11.00
7	6.20	5.00	10.40
8	7.00	5.00	10.00
9	7.50	5.10	9.20
10	8.40	5.10	8.30
11	9 40	5.10	7.30
12	10.40	5.10	6.30
13	11.40	5.10	5.30
14	12.50	5.10	4.20
15	1.50	5.10	3.20
16	2.50	5.10	2.20
17	3.50	5.10	1.20
18	No	light.	0.00
19	No	light.	0.00
20	No	light.	0.00
21	5.40	7.30	1.50
22	5.40	8.00	2.20
23	5.40	8.40	3.00
24	5.40	9.20	3.40
25	5.40	10.10	4.30
26	5.30	11.00	5.30
27	5 30	12 00	6 30
28	5.30	1.00	7.30
29	5.30	2.00	8.30
30	5.30	3.10	9.40
31	5.30	4.20	10.50
Total number of hours,			196.10

The foregoing schedule is practically good for the United States.
The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.
The time for lighting or extinguishing is given for the day on which the night commences.
The time up to 12 o'clock midnigh is shown by bold face type; after midnight by light face type.

THE ELECTRIC LIGHT.

The Western Electric company of Chicago has sold a 75-arc light plant for export to South America.

The Santa Rosa Lighting company will build gas and electric light works and sell fuel in and about Santa Rosa, Cal

The Brush Electric company has recently sold to parties in Princeton, N. J., a 225 light incandescent plant complete.

The Chicago Arc Light & Power company is crowded to its full capacity, the night service, in fact, being overtaxed.

The Heisler central station plant at Ocean Grove, N J., has been installed to the entire satisfaction of the local company.

The city of Easton, Pa., has increased its plant by purchasing twenty-five arc lights of the Western Electric company of Chicago.

The Heisler Electric Light company has contracts on hand for the construction of central stations at Greenport, N. Y., and Yonkers, N. Y.

The St. Paul, Minn., Gas company has purchased of the Thomson-Houston company of Chicago, 50 arc lights as an increase to its present plant.

The Milwaukee county asylum for the chronic insane has purchased a 150 light incandescent plant of the Thomson-Houston company of Chicago.

The Thomson-Houston Electric Light & Power company of Meridian, Miss., has ordered 75 arc lamps of the Thomson-Houston company of Chicago.

Alex. Kempt, agent of the Brush Electric company in Chicago, has recently sold a 300 light incandescent plant complete to parties in La Salle, Ill.

A funny fool in New York touched an electric light wire so as to see the light "sputter." He will not "sputter" any more; aged 24.—*Buenos Ayres Herald.*

The Snohomish W. T., Electric Light company, has been incorporated; stock, $8,600; incorporators, E. C. Ferguson, T. Ferguson, C. H. Stickles, I. Cathcart and others.

The Eugene City, Ore., Electric Light company has placed an order for 600 additional Heisler incandescent lights. The plant was started last year.

The Gaslight & Coke company of Jacksonville, Ill., has purchased as an increase to its present plant 50 arc lights of the Thomson-Houston company of Chicago.

The Western Electric company of Chicago has sold forty arc lights to the Western Electric Light company of St. Louis, as an increase to the present plant.

The Bristol, Pa., Electric Light & Power company has been incorporated, with $30,000 capital stock. The plant will probably be in operation by December 15th.

The Electric Light & Power company of Litchfield, Ill., has purchased as an increase to its present plant 35 arc lights of the Thomson-Houston company of Chicago.

The Calumet & Hecla Mining company, of Calumet, Mich , recently increased its electric light plant by purchasing a number of 2,000 candle power Brush arc lamps.

The Electric Light company of Carlinville, Ill., recently purchased through Alex. Kempt, Chicago agent of the Brush company, two 150 light incandescent dynamos.

The Brush Electric company has sold to the Brown Hoisting & Conveying Machine company of Cleveland, O., a large arc and incandescent electric light plant for its shops.

The Ceffingwell electric light plant in Shreveport, La., was recently burned. The plant was erected by C. A. Ceffingwell two years ago, and cost $16,000, and was not insured.

The electric light dam and main building in Neenah, Wis., were washed away by high water last week. The dynamos are at the bottom of the river. The loss is estimated at $38,000.

The *Gasfitters' Review* of London says a gas engineer has acknowledged that electricity has one field in which gas cannot compete. The reference is to the lighting of carriages and omnibuses.

Vund, Kyne & Kennedy, of Amsterdam, N. Y., have recently increased their Brush incandescent electric light plant by purchasing a 225 light dynamo from the Brush Electric company, Cleveland, Ohio.

An electric light company has been formed at Kirksville, Mo., which will operate about forty arc lights and 300 incandescent lights. The plant will soon be started. Benjamin F. Lamkin is interested in the company

The Heisler central station at Grand Junction, Col., will be in operation in a few days. The constructing electrician will then leave for Pueblo, Col., where the same company is erecting a large central station plant for the gas company in that city.

The Atlantic cotton mills, Lawrence, Mass., who have operated 45 Waterhouse arc lights the past year, have ordered 77 arc lamps in addition. They turn on and off lights at will, the Waterhouse regulator working perfectly under light or full load.

The Truckee Electric Light & Power company has been formed. The capital stock is $6,000 and the incorporators are W. H. Kruger, J. F. Moody, Joseph Marzin, J. L. Lewison, T. B. Whitney, W. H. Hurd, George Curless, W. P. Moss, C. T. McGlashan.

The Buffalo common council at the meeting of September 24 voted to extend the electric light system in the city Several aldermen opposed the extension on the ground of economy, but the majority preferred the better illuminant even if it cost slightly more than gas.

A committee consisting of Messrs. Chiles, Watkins and Lemm, of the Jackson, La., city council are visiting northern cities for the purpose of inspecting different systems of electric lights, which they will consider before finally accepting a bid for lighting their own city.

The Brush Electric company, of Cleveland, O., has recently sold to Woods, Jenks & Co., of the same city, a 30-light 2,000 candle power dynamo with a full complement of lamps. The same firm recently purchased from the Brush company a large incandescent plant of three or four hundred lights.

The steamer Queen of the Pacific was recently fitted out with electric lights. She was so brilliant when she steamed into San Diego harbor the other evening that the startled citizens got the impression she was on fire, and a number of tugs and other vessels were hastily made ready and sent to her assistance.

The San Antonio Gas company, of San Antonio, Tex., has just added to its electric light plant by purchasing another 30-light 2,000 candle power arc dynamo from the Brush Electric company. This plant is a new one installed within the last year. The company is now operating 150 Brush arc lights.

The Spanish government has refused to alter the date fixed for the compulsory introduction of the electric light in the Madrid theaters, and no place of entertainment will be allowed to open this autumn unless lighted by electricity. The majority of the theatrical managers have complied with the ministerial decree.

The new Lyceum theater at Rochester, N. Y., will be lighted by 750 electric lamps. Thirty-six globes each containing two lamps of sixteen candle power will be placed in the dome of the auditorium, and thirteen chandeliers of electric lights will be placed advantageously in other parts of the house. The dome lights will be inclosed in globes of pearl glass.

Mr. Shippey has patented a new filament, prepared from semi-metallic material, which he claims is free from the previous patents, says the London *Electrical Engineer*. Another part of the patent consists in a method employed by him of using up old or damaged filaments. Instead of being useless, as heretofore supposed, Mr. Shippey states that old filaments, being of very pure carbon from the con-

tinued action of the current, can be pulverized and remade into filaments, making a better quality of filament than the original.

Alex. Kempt, at the head of the Chicago house of the Brush Electric company, has sold an electric light plant of two 2,000 candle power Brush dynamos with full complement of lamps, to the Lehigh Coal company of Duluth, Minn., and in addition, to be operated in connection with the plant, one 18 horse power motor and one 11 horse power motor.

Following are the inco-porators of the Baker City, Ore., Gas & Electric Light company: J. H. Parker, J. P. Faull, J. W. Wisdom, Chas. F Hyde, Henry Rust, O M. Dodson and E. H. Mix. The articles of incorporation state that the objects of the company are the "building, erecting, owning, operating and controlling a full and complete system of gas and electric light works" in Baker City.

A local paper says of the electric light plant at Hoosick Falls: "The lights are of the Thomson-Houston system, and give perfect satisfaction; steady, no flickering, brilliant. More lights are necessary, and we hope our village fathers will not delay the matter, but decide early upon their location. And too, a judicious trimming of the trees will not only increase the benefits of the lights, but beautify the appearance of our village. The plant consists of an Armington & Sims 50 horse power engine, a 100 horse power boiler, and two arc light dynamos of the capacity of 30 lights each."

C C. Haskins, city inspector of electric lights, would not permit an arc light to be placed in the dome of the Columbia theater in Chicago, unless extraordinary measures were taken to prevent fire from sparks from the carbons. He, therefore, designed protective measures himself The space above the lamp and at the sides was lined with asbestos and a mercurial thermostat inserted. The thermostat was placed in circuit with a battery and a vibrating bell located on the stage in the vicinity of the electrician in charge. In case a fire originates from the arc lamp or the temperature of the air surrounding it increases beyond the normal, the bell sounds the alarm and the electrician at once cuts the lamp out of circuit.

The *County News* speaks of the electric light plant installed by the Brush company in Marysville, Kan., in this way: "The lights are clear, bright and steady, and satisfy the most skeptical and surpass the expectations of the most enthusiastic. The dark days of our city are past, and we are willing that our prosperity and pride, business and beauty, shall be inspected by the bright light of the noonday sun, or the more brilliant glow of the electric lamp. The spirit of public and private improvements predominates among our people. The light has dawned upon us in more ways than one. We take the lead as a city and as a people, and say unto others, gather beneath our light and it will lead you to pleasant and profitable places "

Harry P. Roberts of Rochester, is the inventor of a crane for raising and lowering electric street lamps. The object of the invention is to provide a safe, strong appa ratus for lowering the lamps when necessary to adjust the carbons. In place of the ordinary counter-weights on swinging cranes, Mr. Roberts employs an endless chain running over a toothed wheel and worked by a crank attached to a bracket on the pole to raise or lower the arm carrying the lamp. His invention also embraces an automatic cut-off, by which, when the lamp is lowered from its ordinary position, the electric current is cut off absolutely from the lamp. One of the cranes has been placed at the main entrance of the international exhibition at Buffalo.

A Syracuse entomologist recently had a narrow escape. He already has a large collection of fire flies and as he was walking down one of the main thoroughfares he thought he saw a chance to increase the number of insects by securing an unusually fine specimen. He took out of his pocket an envelope with which to entrap it. Just as he was on the point of attempting the capture a policeman caught him by the shoulder and dragged him away. According to the story the luminous object was not a fly but was a minute arc on an electric light wire which had fallen from a pole. The policeman had taken in the situation and had saved the man's life. The story sounds a little fishy but as it is vouched for by the entomologist himself it ought to be believed in all its details. The experience should be a warning to all naturalists not to hunt for specimens in city streets.

In the office of the *Public Ledger*, in Philadelphia, on Tuesday evening of last week, L. H. Leher gave a public exhibi ion of his regulating incandescent light, by which the illuminating power of a lamp, it is claimed, may be increased from the 1-16th of a candle power to 112 candle power, says an exchange. The change from one power to another is effected by diverting the current from one carbon loop to another, and the number of changes in any one lamp is limited by mechanical considerations, as there must he a loop of carbon for each power, besides means for making the connections with each loop. In the demonstration a lamp was connected with an Edison electric light circuit, and the light changed at will from an eight candle power to a sixteen, and then to a thirty-two power, one carbon filament being used for each power desired, and the same current being used in each case.

In a communication to the Academie des Sciences of Paris M. C. Ponak describes a form of arc lamp in which the regulation is effected by the expansion through heating of wires. The current passes to the carbons through a brass wire, sufficiently thin to be sensibly heated by the passage of the current, and which is kept stretched by a helical spring, also of brass, and the other end of these springs is connected by a magnifying lever with the carbon-holders. Before turning on the current the carbons are in contact, but on closing the circuit, the current passing through the wires mentioned above cause them to stretch, separating the carbons. When the arc is formed, its resistance limits the current passing through apparatus, and with it the elongation of the wires, and a steady light is obtained. As the carbons waste away the increased resistance diminishes the expansion of the wires, and allows the two carbons to approach each other. It is claimed that with this apparatus the light can be maintained for three hours without attention, and the relighting in case of extinction is automatic, but the intensity of the light increases slightly during work. The apparatus is stated to work well, giving little trouble, owing to its great simplicity, as neither gearing nor electro magnets are employed, the whole regulator being made from a block of wood and four brass wires.

THE ELECTRIC MOTOR.

There is some talk of an electric railroad between Lowell and Lawrence, Mass.

The electric road at San Jose, which disappointed its projectors for a short time, is now running satisfactorily.

The Sprague Electric Railway & Motor company has secured the contract to supply an electric motor and gearing to the turn-table of the Pennsylvania railroad at Altoona. The Yale & Towne company will furnish the table itself. The Sprague company recently installed a railway turn-table at Aurora, Ill., for the C., B. & Q. R. R This table is 325 feet long by 66 feet wide, and has a tractive resistance, when full loaded, of about 1,500 pounds. The table weighs, light, about 15 tons, and moves loads of 100,000 pounds with ease. The installation has been in operation for nearly a year without hitch or breakdown, and to the entire satisfaction of the railroad company.

In the large tobacco warehouse of Ferguson, Herndon & Co., Louisville, Ky., the practical use and superiority of the electric motor over any other form of power is clearly demonstrated. The firm used for some time a 10 horse power gas engine, but finding it wholly unequal to the duty it had to perform they displaced it with a 12 horse power steam engine. With the latter power they found an improvement, but it was not wholly reliable and trustworthy. They finally purchased a 7½ horse power Sprague motor, which is now doing the work formerly done by the gas and steam engine, and is also furnishing additional power required by fruit presses for compressing dried fruit.

Work on the machinery of the electrical equipment for the West End Street Railroad company of Boston, to be equipped by the Sprague system, is being pushed forward at the factory as rapidly as possible and will soon be ready for installation. The overhead structure will be of the most neat and tasteful description. The poles will all be of iron of ornamental pattern, and will be set in concrete. These will carry the light and small number 6 overhead wire which is used upon all the Sprague roads. The power station will be placed at Allston on the Boston & Albany railroad, and will have both water and rail facilities for receiving fuel. The dynamos will be of the largest size and of the Edison pattern. The first part of the equipment will consist of 20 cars which will all be ready for operation by the first of October.

The directors of the Hartford & Wethersfield Horse Railroad company, with representatives of the press, recently enjoyed a ride to Wethersfield in one of the new electric cars which the Sprague company has just equipped in that city. Starting from the depot at 4 o'clock the run down was made in twenty minutes, without any special attempt at speed. The car can be as easily stopped as with horses, as a slight turn of the switch crank shuts off all power, and the brakes work as at present on the regular horse cars. The return trip was made in eighteen minutes. The trial was satisfactory to the directors, who expressed themselves as well pleased at the easy motion of the car in starting, rounding curves, and in speeding. The trip to Wethersfield was made two minutes ahead of schedule time, and the return trip was accomplished in six minutes less than the regular time. Among those who were on the trial trip were President Goodrich, Messrs. Roland Mather, Henry Keney, Charles L. Lincoln, Atwood Collins, Samuel G. Dunham, Daniel Howe, Judge Henney, A. P. Pitkin, Ebenezer Roberts, Alderman Henney and Selectman Horace Robbins, of Wethersfield.

The organ in St. Paul's chapel, rich in the solemn, mellow harmonies of many Sundays, and venerable in its abundance of years, recently was wedded to a creation of modern progress, says a New York paper. The old man who for years had pumped power into the lungs of the great instrument, was absent. His occupation is gone, and the bellow's arm, worn into a smooth polish from many handlings, has ceased to make its regular upward and downward beats. Modern science, cold and unappreciative of tradition, had come into the quiet atmosphere of the old place of worship, and when organist Leo Kefler touched the keyboard the power which quickened the organ into voice was furnished by electricity In the latter part of August an electrical motor was placed on the floor near the organ, but in the several experiments that followed it was found that the vibrations of the machine were too perceptible. It was tried in several positions, and was finally found to give satisfaction, and make no noise when placed above the entrance to the choir. The power is furnished by the Edison company. The contrivance is under control of the organist, who at the keyboard can apply or cut off the power by touching a button at his side.

The construction work on the Brookline branch of the West End railroad at Boston is being pushed forward as fast as possible, and is rapidly nearing completion. About twenty cars will be at first fitted out with the overhead Sprague system for Brookline, and the Bentley-Knight conduit system will be used in Boston, where overhead wires and poles are forbidden. It is impossible to estimate when the road will be completed, but it is hoped that it will be in running order before snow flies. The road has been guaranteed to run without a hitch Sprague motors will be used on all the cars, and the only portion of the Bentley-Knight system used will be the conduit and the plows from which the current is taken therefrom. In the Bentley-Knight system in Allegheny the conduit is in the center of the track, and the plows in the center of the cars. In Boston, however, it is proposed to place the conduit by the side of the track, and the plows outside the wheels of the car, but protected by the overhang of the curved sides. The Sprague overhead system will be the same as that for the Richmond road, except that iron posts will be used instead of wooden ones, and will be much stronger as well as more ornamental. A part of the equipment furnished by the Sprague company will consist of three working cars for clearing snow from the tracks in winter. Each of these is operated by two fifteen horse power motors and carries snow plow, ice cutter salt and sand arrangements, and will keep the track clear in all sorts of weather.

A London firm has made an electric dog cart for the sultan of Turkey. The motor is of one horse power capacity. The motive power is supplied by a set of twenty-four small E P. S. accumulators, placed in the body of the cart, of sufficient storage capacity to drive the dog cart for five hours at the speed of ten miles an hour. The weight of the accumulators is 7 cwt., and that of the carriage, all complete, is 11½ cwt. The motor uses a current of 20 to 25 amperes, with an e. m. f. of 48 volts. When the vehicle is running at a speed of 10 miles an hour the motor makes 1,440 revolutions per minute, and develops ¾ actual horse power. The motor is connected to one of the wheels by means of a chain, gearing into a sprocket wheel on the motor shaft. The ratio of gearing of motor to driving wheel is about 18 to 1, the circumference of the wheel being 10 feet 9 inches. On an ordinary road the amount of work required, of course, varies with the uphill or downhill gradient, and the total amount of work done is thus, on an average, about the same as on level road. The current required to start is about 25 amperes, and for very heavy gradients as much as 45 or 50 amperes could be taken for a few minutes without harm. The motor has been tested up to 90 amperes. The dog cart carries four persons; it is started, stopped and guided without any difficulty by means of a switch, with three resistances, and a steering gear fitted to the fore carriage, with a handle for the driver. The cost is £200. Rather a rattling noise is made by the commutators and sprocket wheels, but this is said to be not noticeable on ordinary roads above the noise of the wheels.

THE TELEPHONE.

Business in the telephone exchange in Grand Rapids, Mich., was suspended for a considerable time on Sept. 27 by the excitement following the discovery that one of the operators had committed suicide. She had taken poison and fell to the floor dead soon after the exchange had opened.

London, with a population put at 4,765,000, contains only 4,193 subscribers to the telephone, while Stockholm, with a population of only 215,000, has 4,832 subscribers. Out of twelve of the principal cities of Europe, London stands last but two in telephone progress, the average of subscribers here being 0.9 per 1,000, as against 22.5 in Stockholm, 6.4 in Rome, 3.3 in Berlin, and 1.4 in Paris.

One of the first persons to profit by the telephone which now connects Paris with Marseilles was the King of Portugal, who, as soon as he landed in France, placed himself in telephonic communication with his wife, who is at present making a stay in Paris. Though the line is 920 kilometers long, it works in all respects as satisfactorily as any of the shorter lines already in existence. The rates at present charged are a franc and a half between Lyons and Marseilles, two francs between Paris and Lyons, and three francs between Paris and Marseilles, the time being limited to three minutes in all cases. The tariffs have hitherto been based on a time allowance of five minutes, but the public will lose little or nothing by the curtailment, experience having shown that the average duration of a telephonic conversation does not exceed three minutes.

Considerable money is being put into long distance telephones in Europe. The telephone lines, Berlin-Dresden and Berlin-Breslau are completed. The distances are 105 and 200 miles respectively. The Dresden line was opened for traffic just recently, and the line may be used by telephone subscribers from their own instruments, and also by the general public making use of the call offices throughout the town or at the Bourse. The charge is 1s. for five minutes' conversation. The Breslau line is yet the subject of experiments by the postoffice, but will also shortly be opened for traffic. A Brussels firm has received an order from the Portuguese government for all the material necessary for the erection of a telephone and telegraph line between Oporto and Lisbon, similar to those at present existing between Paris and Brussels, and Lyons and Marseilles.

A dispatch from Philadelphia, dated September 22d, says: Henry Brown, an employe of the Bell Telephone company, was standing on a scaffold level with the fifth story of the building, 26 South Fifth street. A rope hung down from the scaffold and lay uncoiled along the road bed of Crockett's court, which lies in the rear of Fifth street. Brown, working at a height of 100 feet above the ground, glanced downward and saw a wagon driven by a negro going out of the court. As it passed beneath him the rope caught in the wheels, became entangled and tautened swiftly. Brown saw what was coming, and shouted to the driver. The negro heard him, looked at him, and then drove calmly on. An instant later the scaffold, torn from its fastenings by the strain, crashed to the ground. As the strands began to separate Brown made a desperate leap for life, jumping upward toward the roof, over which he had been trailing some wires. His feet touched the ledge, but he could not recover, and in another instant he toppled head foremost to the pavement below, uttering a piercing shriek as he fell. He struck upon his head, and his skull was crushed like a shell. For a dozen feet around clots of blood and brain were spattered. The unfortunate man was dead before a bystander could reach him. The driver, seeing what he had done, descended from his seat and coolly disengaged the rope from the wheel. Then, resuming his place, he whipped up his horse and drove off. The catastrophe oc-

curred within 50 yards of the central police station, but whether through his own alertness or through the slowness of the police, the negro drove away unmolested, and there is no clew to his identity.

THE TELEGRAPH.

A dispatch from Valparaiso says: The Transandine Telegraph company will open to the public its new direct telegraph line between Valparaiso and Buenos Ayres October 1st. This is an iron pole line in connection with forty miles of cable laid under the perpetual snows of the Andes, and will insure communication between Buenos Ayres and London via Galveston inside of one hour and a half.

A Washington dispatch says: The Postal Telegraph company has applied to the Inter-State commission for an order giving it means of connection over the American Pacific roads which are now giving exclusive privileges to the Western Union. The company says its only connection with the Pacific coast is over the Canadian Pacific lines, which are not only inadequate for its business, but are liable to interruption.

An eastern paper says of the system of using dynamos instead of batteries for telegraph lines: "The dynamos were found in the cellar of 187 Broadway, New York, occupied by the Postal Telegraph Cable company. Their arrangement is a decided improvement over the previous substitution of this class of mechanism for the immense batteries that have been made in this city. They occupy but a small portion of the space required by the batteries, and yet are much more effective and reliable. The arrangement of the dynamos, driven by small engines, is on a plan devised by F. W. Jones, manager and electrician of the company, and highly commended by other electricians. By a simple process of switching they can readily be connected with any of the wires and a current flashed over any of the company's lines which connect directly with Washington, Boston, Cincinnati, St. Louis, Chicago, Omaha, St. Paul, Denver, San Francisco, and other points in this country, and Liverpool, London, and other cities in Europe."

Miscellaneous Notes.

The electrical works of Dorsey, Paine & Co., at Chattanooga, Tenn., have been burned. They will be rebuilt at once.

The Electric Machinery company of Chicago has been incorporated. Capital $100,000; incorporators, E. H. Haynes, Charles Steinbreiss and H. B. Cady.

An inventive mechanic of Bridgeport, Conn., has perfected a locomotive attachment which utilizes the phonograph in a new way. By means of the device every blast of the engine's whistle is recorded, together with the exact time at which it occurs. This will, of course, be of great value to railroad companies in protecting them from the false representations of persons who are injured or mutilated while on the track.

A galvanometer for the direct measurement of very small currents is shown by Mourlon of Brussels, at the Brussels Exhibition. It will probably be most useful to medical practitioners in electrical treatment who require to measure currents of a small amount. The instrument indicates directly, and without oscillations, currents from one 1,000th up to one ampere. A resistance of sulphate of zinc and water completes the apparatus, which is handsomely mounted.

The twenty-eighth meeting of the American Institute of Electrical Engineers, and the first of the present season, will be held at the house of the American Society of Civil Engineers, 127 East 23d street, New York, Tuesday, Oct. 9. The programme of the evening will be the discussion of Frank J. Sprague's paper, on "The solution of the municipal rapid transit problem," read at the last special meeting of the institute, June 19th. Messrs. M. B. Leonard of Richmond, George W. Mansfield of Boston, and Robert W. Blackwell of New York, have signified their intention of discussing the paper.

An Austrian engineer has, it is said, designed a truck to be run before every railway train, being maintained always at a fixed but adjustable distance in front by the force of an electric current transmitted from a dynamo on the engine. The current is conducted in glass tubes on the pilot truck. If the truck comes into collision the tubes are broken and the contact necessarily destroyed. The interruption of the current instantly and automatically applies the brakes on the following train. It is claimed by the inventor that two express trains, fitted with this system, might with impunity be set to run full tilt at each other. The collision of both pilot trucks would arrest the progress of both trains before they could meet.

Here is what a prophet in the St. Louis *Globe-Democrat* predicts: "The time will come when electricity will be as essential to ordinary housekeeping as bread and milk now are, and will be delivered to private dwellings something after the style that milk and bread are now delivered. A wagon will drive up to the back door and leave a box of electricity, sufficient to last at least twenty-four hours. The housewife will take the box and attach it to the electrical apparatus in her house, and run her sewing machine with it during the day and light her dwelling with it at night. The next morning the wagon will call and the old box will be taken away and a new one substituted, and thus it will go on from day to day. This can be done now with much more ease than a storage battery of an ordinary electric motor can be filled, and at very much less expense. In fact, if such a system were in general operation the cost would be almost nominal."

The Domestic Gas company of Chicago has been incorporated, with a capital stock of $500,000. The incorporators are A. G. Anderson, R. H. Smith and A. A. Exline. A gentleman interested in the company said: "The system is one to enable a man to supply gas in his house through the working of a machine, which is practically a permanent battery. This electric machine produces the hydrogen part of the gas, and the carbon is supplied by utilizing some product of coal oil, thus making a fixed gas. The cost of this gas to the consumer will, of course, be mainly regulated by the cost of the carbon-making material, but even at retail per gallon in the market the price of the gas should not be over 30 cents per 1,000 feet. There is no increased risk to advance insurance, as the coal oil reservoir, made of metal, can be kept outside of the house, and connected by a pipe or tube with the gas-making machine. I have for some time past used one of these gas-making machines in my own house, and the results from it are highly satisfactory."

A paper was recently read before the French Academy of Sciences by Messrs. Chaperon and Mercadier, describing an electric cell which is sensitive to the action of light. The cell consists of a plate of bright silver covered with a thin layer of sulphate of silver, and immersed in an electrolyte composed of a very dilute solution of sulphuric acid. The cell forms a very unsatisfactory and unprofitable article so far as its electric properties are concerned, for its e. m. f. is weak and variable, and polarization takes place rapidly. The peculiarity of the arrangement is that its current undergoes an instantaneous change when it is exposed to the action of light. The rapidity with which the change takes place has been investigated by the authors, who have demonstrated that so short a period of time as one thousandth of a second is sufficient to produce the effect of the light on the e. m. f. of the cell.

Personal Paragraphs.

Mills H. Landon, cashier of the New York branch of the Western Electric company, was in Chicago last week.

William Hubbard of the Elgin Telephone company, of Elgin, Ill., has been seriously ill for two weeks, but is now convalescent.

Prof. E. P. Roberts, formerly of Cheyenne, Wyoming Territory, has been appointed to the chair of electrical engineering in Cornell university.

Frank E. Clark has resigned his position as secretary and treasurer of the Campbell Electrical Supply company, of 95 Milk street, Boston, Mass.

J. E. McConnell, of the H. B. Cox Electric company of New Haven, Conn., was in attendance at the meeting of the Chicago Electric club Monday evening last.

President Duncan, of the National Electric Light association, was in Chicago the early part of the week, and was a visitor at the Chicago Electric club Monday evening last.

Prof. Eric Edlund, member of the Royal Academy of Science of Sweden, died at Waxholm, near Stockholm, on the 19th of August last, in his 70th year. The celebrated Swedish professor contributed greatly to the knowledge of modern science in connection with electrical research.

William Pataky, from the Royal Polytechnicum of Berlin and a member of the Institute of Patent Agents in London, was in Chicago recently. He said to a reporter that the German patent law, which is patterned somewhat after the laws in the United States, would be changed within a year. The new law will give a personal hearing to the patentee on appeal cases, and a court will be established of higher powers than the patent office. Where an appeal to the patent office has been decided adversely it can be made to the court. A board composed of scientists and manufacturers asked for a law of this character last year. Mr. Pataky said that American inventors were liked in Germany because they were practical men, and their inventions good.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	340	345
Central Union	47	48
Michigan	81	82
Great Southern	34	37
Colorado	43	46
Rocky Mountain Bell	41	43
Cumberland	65	68
Wisconsin	110	112
Bell of Missouri	150	155
Iowa Union	28	29
Missouri and Kansas	70	71

Business Mention.

The Merced, Cal., Heisler central station plant, under construction for the Merced Gas company, will be completed and started in a few days. The order for this plant was very gratifying to the Heisler Electric Light company. Mr. Swain, the superintendent, awarded the contract to the Heisler company after having made a personal and thorough investigation of the working of all others as well as of the Heisler system at Salt Lake and Ogden, Utah.

The Davenport Central Railway company of Davenport, Ia., under date of September 22, wrote as follows to C. M. Barclay, agent at Chicago of the Sprague Electric Railway & Motor company: "We accept the equipment furnished by your company for the operation of our road. We have found in the peculiar location of our long grade a most trying obstacle. Your motors have been able to overcome this and in such a successful manner that we now believe our heavy grade is a source of financial benefit, our travel having increased more than 50 per cent."

The Southwestern Electrical Supply company of Kansas City announces that it has opened a department which will be fitted up for the purpose of doing a general business in the way of repairing dynamos armatures, lamps and electric lighting apparatus. This department will be under the direct supervision of an expert electrician which will enable the company to guarantee all its work so that persons sending any kind of apparatus to its shops for repairs may feel assured that the work will be done in a satisfactory manner. The demand for a place of this kind has been felt by every manager of an electric lighting company in the territory tributary to Kansas City. A great saving will be gained in transportation, and delays attending long shipments will be done away with.

Edw. P. Allis & Co., of Milwaukee, Wis., in order to meet the demands of their great trade for a first-class and thoroughly reliable line of mill and engine supplies, have organized a supply department and carry in it the more prominent lines of leather, cotton and rubber belting, lacings, belt fasteners, and the miscellaneous lines of accessories, sprocket wheels, steel and iron hoisting transmission and standing ropes and fittings, rubber goods, including hose and fittings, elevator buckets and conveyors, scales of all kinds, speed indicators, flouring mill supplies, lanterns, flue cleaners, vacuum oils, lubricants and lubricators, oilers and a number of specialties. Inasmuch as they place their seal of recommendation on their goods in their supply department it is quite evident their large trade will know when they order goods from the supply department that they will get as good as there is.

For some time it has been known that the president and directors of the West End Street Railway company of Boston were investigating with great care different methods of street car propulsion, including the cable and various electrical systems. They have made it a point to visit principal cities in this country where these systems are in operation, and have made a rigid examination. They have evidently been governed by the desire to make the best possible move for the improvement of street railway facilities in Boston The company negotiated for a time with the Thomson-Houston company. Mr. Whitney and his board greatly admired this company's road at Crescent Beach, where, during the season, hardly a scheduled trip was missed. This fact, they thought, gave pretty good assurance of the reliability of the system Negotiations culminated September 14, when Mr. Whitney signed a contract with the Thomson-Houston company. They are to begin at once the construction of a line from Harvard Square, Cambridge, to Arlington, to run by the overhead system. The cars will be running within sixty days, and very soon afterward a line will probably be running to Bowdoin square, Boston proper. The Thomson-Houston company has at present nineteen roads in successful operation. They are at Scranton, Pa. (3); Revere, Mass. (2); Syracuse, N. Y.; Washington, D. C.; Ansonia, Conn.; Binghamton, N. Y.; Detroit, Mich.; Jamaica, N. Y.; Port Huron, Mich.; St. Catherines, Ont.; Wheeling, W. Va.; Appleton, Wis.; Dayton, O.; Fort Gratiot, Mich.; Lima, O., and Windsor Ont. There are also roads in process of construction at North Adams, Mass.; Wichita, Kan.; Des Moines, Ia.; Omaha, Neb.; Lynn, Mass; Danville, Va; Hudson, N. Y.; Seattle, W. T., and Bangor, Me.

During the past week the Sprague company has closed three contracts for the electrical equipment of street railways in Erie, Pa., Reading, Pa., and Asheville, N. C. The first named company is the largest in the city of Erie, and operates twelve miles of track and over 100 horses. The contract specifies the equipment of twelve cars, and calls for the overhead system. The electrical appliances will embody all the latest improvements introduced by the Sprague company upon its railroads. At the central station there will be four dynamos of 50,000 watts capacity each, which will deliver the current to the line at a pressure of 500 volts. The overhead wiring will carry the light number 6 bronze wire for a working conductor, which is in use upon all the Sprague roads. The East Reading Street railroad runs out Fairview avenue, and covers about a mile and a half of street. The same overhead system will be used as on all the Sprague roads, and the poles will be of a neat and tasteful design. The Asheville road is three miles in length. At St. Joseph, Mo., the successful operation of the Sprague system on the road of the Union Passenger company of that city has decided the Wyatt Park Street Railway company to adopt Sprague motors and overhead wiring upon its cars. The Union Railway company has also contracted for an extension of the Sprague system upon its road. Two other street railways now using the Sprague system over parts of their roads, have decided to extend it over the whole. These are the Wilmington City Railway company of Wilmington, Del., and Suburban Railway company of Wilkesbarre, Pa. They have both been in operation for about three months, and have been giving perfect satisfaction. The first equipments of these were three and four cars respectively. The work on the electrical equipment for the Brockton, Mass., East Side Street railway is being pushed forward as rapidly as possible. It is expected that this road will be put in operation at once.

One of the busiest firms in the west is undoubtedly the Pond Engineering company of St. Louis and Kansas City, engineers and contractors for complete steam plants for all purposes. They now have the following orders on their books: One 75 and one 125 horse power, Armington & Sims engines for the Pine Bluff, Ark., Water & Light company; one 75 and one 125 horse power Armington & Sims engines for the Fort Scott, Kan., Electric Light & Power company; one 42 horse power Armington & Sims engine for the Metropolitan Street Railway company, Kansas City, Mo.; one 75 horse power Armington & Sims engine for the Bank of Commerce Building, St. Louis; one 30 horse power Armington & Sims engine for the county court house, St. Louis, Mo.; one complete steam plant of 200 horse power, including steel boilers, Armington & Sims engines, heaters, pumps, etc., for the Little Rock, Ark., Edison Electric Light & Power company; one 100 horse power steam plant, complete, for driving the new Sprague electric railway at Asheville, N. C. This power plant is an addition to the works of the Asheville Electric Light company.

The Pond company is also furnishing a 125 horse power Armington & Sims engine to the Edison Illuminating company, Topeka, Kan. They have also been awarded the contract for the erection and starting of the 600 horse power plant for the new central Edison station at Kansas City, Mo. They are furnishing a 400 horse power Hoppes purifier to the electric railway between Council Bluffs and Omaha. They have just furnished two 80 horse power boilers to the Crawfordsville, Ind., Gas & Electric Light company, and two more of the same size to the Jacksonville, Ill., Gas Light & Coke company.

Electrical Patents.

Issued September 25, 1888.

389,870. Registering Meter for Electric Currents. James D. Bishop, San Francisco, Cal.

The invention consists of indicating dials with suitable gearing by which they are actuated, an adjustable pawl and ratchet mechanism by which the movements of the indicating dials are regulated, and an oscillating arm or pendulum actuated by the passing current, together with a mechanism by which the movement of the ratchet wheel is increased or diminished in proportion to the current which is passing. The fifth claim follows:

5. "In combination with the alternately acting electro magnet or magnets, a pendulum the rod of which is made flexible between the weight and the point of suspension, an armature upon which the magnets act to cause the pendulum to swing from side to side, and a commutator operated by the swinging pendulum."

389,876. Electric Motor. Philip Diehl, Elizabeth, N. J.

The invention is more especially intended for use in connection with electro motors adapted for driving sewing or other light machines. The seventh claim is given:

"7. The combination, with an electric motor, of a lever provided with a friction block or brake, and a spring adapted either to hold the brake away from the motor wheel or to force it against said wheel."

389,882. Secondary Battery. Camille A. Faure, New York, N. Y.

The invention embraces two electrodes or elements, each composed of different elementary substances and normally widely separated in the electromotive scale, combined with an electrolytic solution forming an insoluble salt with either or both said elements under the influence of an electric current.

389,883. Telegraphy. Stephen D. Field, Yonkers, N. Y.

The invention comprises, in connection with the other devices, a special character of compound relay constructed for use in connection with the multiplex system. The first and fifteenth claims are given:

"1. In telegraph apparatus a receiving relay consisting of coreless coils vibrating in a fixed magnetic field of adjustable strength.

"15. A telegraph relay comprising a closed tubular electro magnet with consequent annular field around the middle of its core, in combination with one or more vibrating coils suspended therein, so as to surround the core."

389,888. Electric Incandescent Lamp and Attachments. Isaac W. Heysinger, Philadelphia, Pa.

389,894. Dynamo Armature. William G. Meyers, Philadelphia, Pa.

389,935. Electric Storage System. William H. McDonald, Albany, N. Y.

The first claim reads: "1. An electric storage system composed of two or more lamp circuits, each of which is supplied with a storage battery, and each of which lamp circuits is connected with the other lamp circuit or circuits by an intermediate circuit provided with a means for breaking the current on the intermediate circuit between the storage batteries."

389,943. Electrical Conductor and Insulating Conduit. Robert F. Silliman, Troy, N. Y.

389,974. System for the Distribution of Electric Energy. Gustav Pfannkuche, Exeter, N. H., and Alfred Pfannkuche, Cleveland, O.

390,001. Elevated Frame Work and Support for Electric Wires and Street Railways. Linus W. Brown, New Orleans, La.

390,058. Telephonic, Telegraphic and Signaling Circuit. Edmond I. Bernheim, Paris, France.

The object of the invention is to provide a system for the installation of telephonic, telegraphic, or other signaling stations connected on one circuit, in order to permit any two stations to call one another directly, and to place themselves in communication without the necessity of giving notice to a central station and without calling either the intermediate stations or the terminal stations of the line. The second claim is given:

"2. The combination of a line having a plurality of wires traversing a succession of stations and grounded at both extremities, with telegraphic, telephonic, or other signaling instruments at the stations, and commutators for putting the circuit wires to ground on either side of these instruments, whereby when one section of the circuit is in use the remainder of the circuit has its terminals grounded, and is in readiness for use."

390,067. Galvanometer. Isaac W. Chisholm, New Concord, O.

390,081. Railway Alarm. Aaron G. Ingham, Omaha, Neb.

390,101. Electric Testing Device for Card Flats. Edmund Tweedale, Accrington, County of Lancaster, England.

The invention relates to apparatus or means for testing the correctness or accuracy of the card flats employed in carding engines.

390,113. Electric Testing Device for Carding Machines. John Bullough, Accrington, County of Lancaster, England.

The invention consists in electrically connecting the card flats and card cylinders and suitably insulating the framing of the machine, so that the circuit may be completed only by the contact of the teeth on the card flats with the teeth in the cylinder, and further, in employing in place of the card flats, with a machine having either an insulated or uninsulated frame, trial or test flats for the same purpose, viz.: for determining the accuracy of adjustment of the surface or rings on which the card flats proper travel

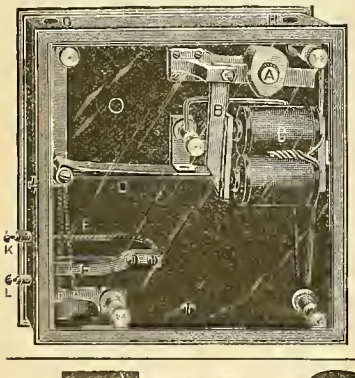
390,115. Electric Current Indicator. Patrick B. Delany, New York, N. Y.

The invention consists essentially in a finger ring having mounted thereon a magnetic needle, and a scale showing the points of the compass.

390,180. Dynamo Electric Machine. William Mather and Edward Hopkinson, Manchester, County of Lancaster, and John Hopkinson, Westminster, England.

The first and second claims are given: "1. In a dynamo electric machine, the combination, with the armature, of the field magnets, comprising solid wrought iron cores, and cast iron poles of much greater sectional area than said cores, the latter being let into the former and being at their ends entirely surrounded by the metal forming the poles.

"2. The combination, with the armature, of the pole pieces having curved bounding lines approximately coincident with the lines of magnetic induction and provided with special polar extensions of small sectional area compared with the poles proper."



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See letter of recommendation from electrician Chicago Arc Light & Power Co., on advertising page xiii WESTERN ELECTRICIAN July 28, 1888.

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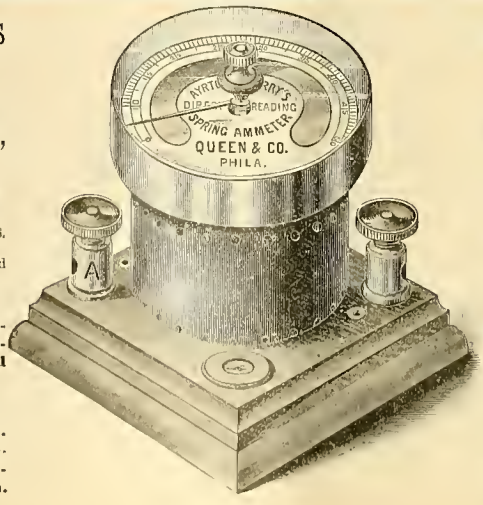

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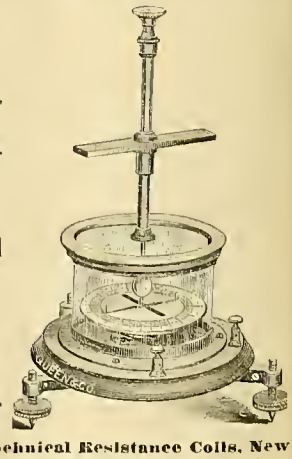

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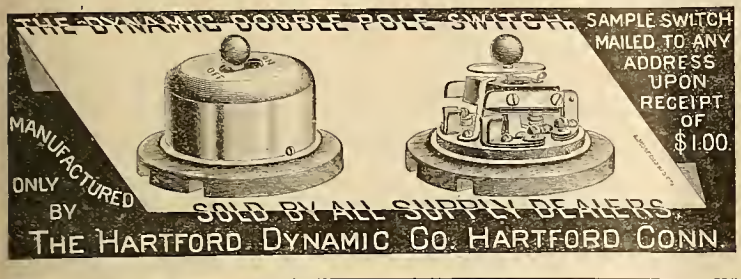

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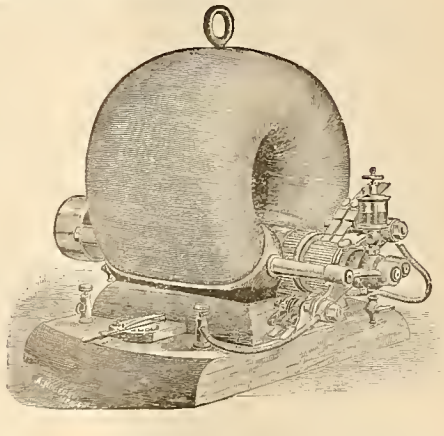

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Each bidder is required to file with his bid a detailed statement of the number and location of the plants then in operation, of the particular system which he proposes to establish in Natchez if successful in bidding, and to specify as to each plant so in operation whether it is the one originally established in such locality or has been substituted for some other previously in use, and, if a substitute, then for what system.

The successful bidder will be required to enter into good and sufficient bond, of such penalty as the Mayor and Aldermen shall hereafter fix, conditioned that he will erect and have ready for use the electric plant, and begin the lighting of the city therewith, on the dates hereinbefore stated.

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Mayor of City of Natchez.

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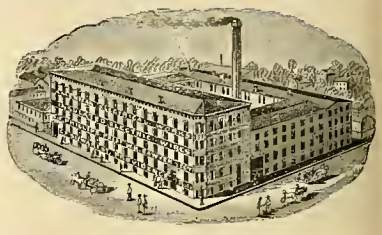

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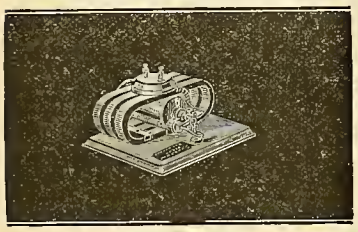

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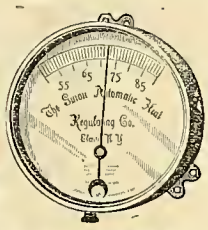

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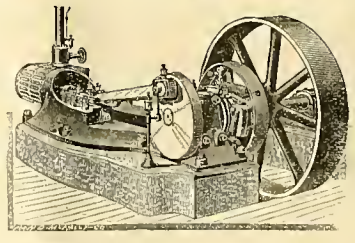

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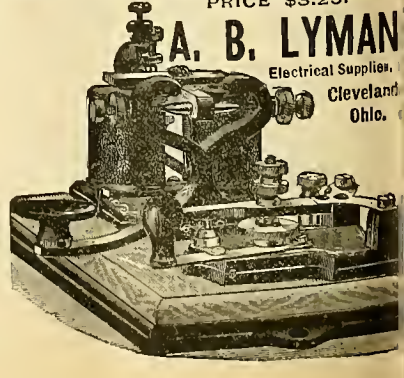

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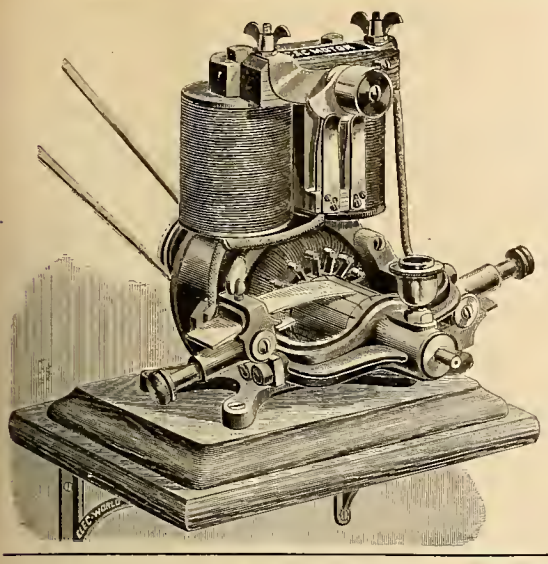

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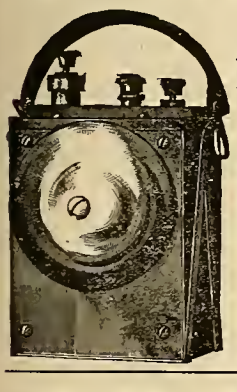

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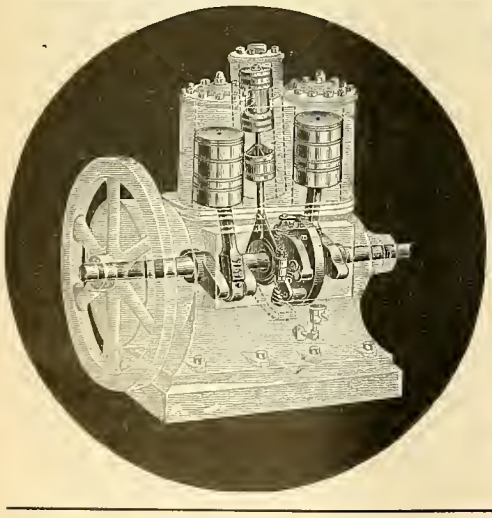

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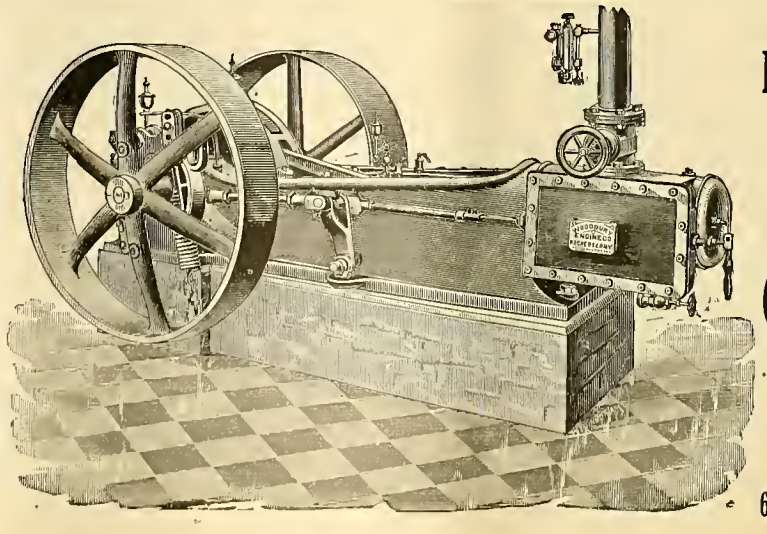

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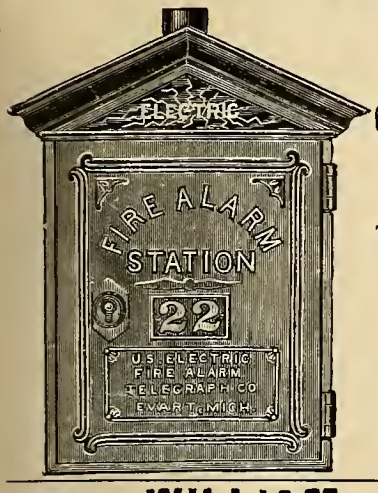

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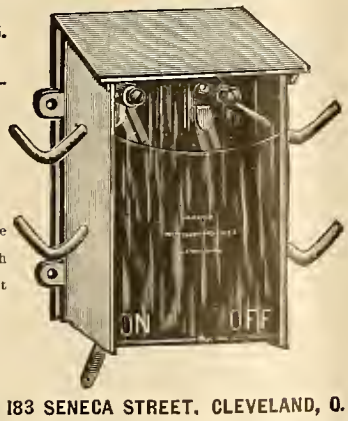

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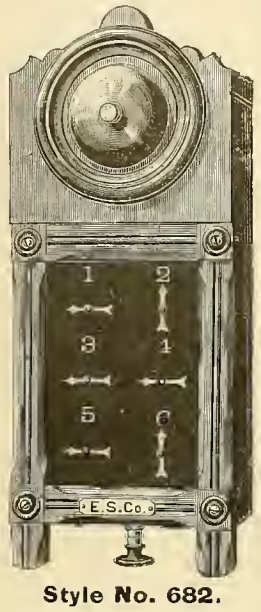

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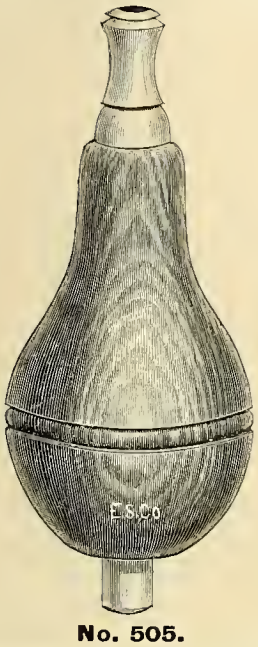

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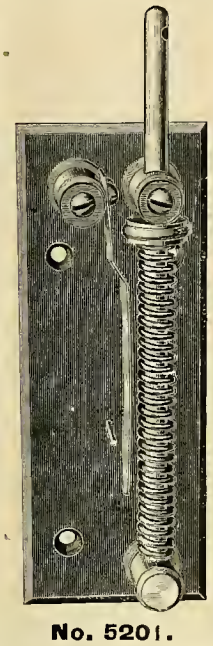

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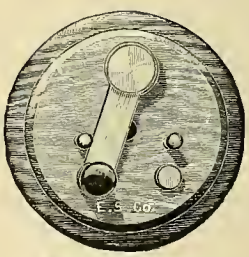

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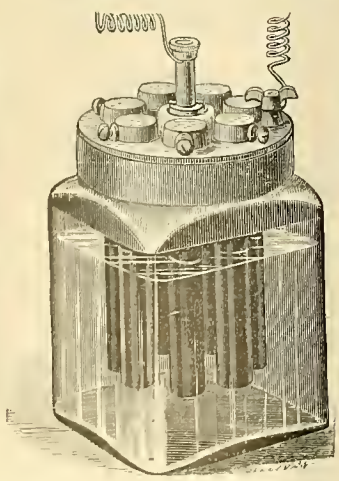

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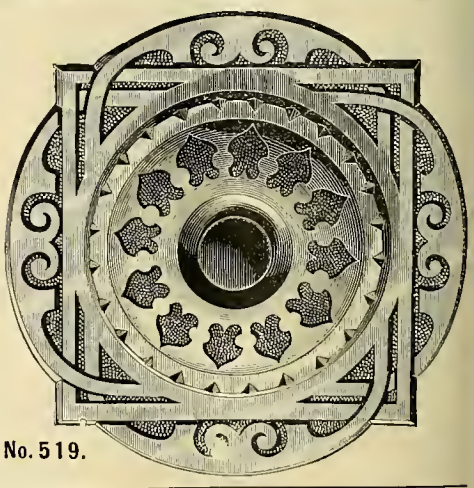

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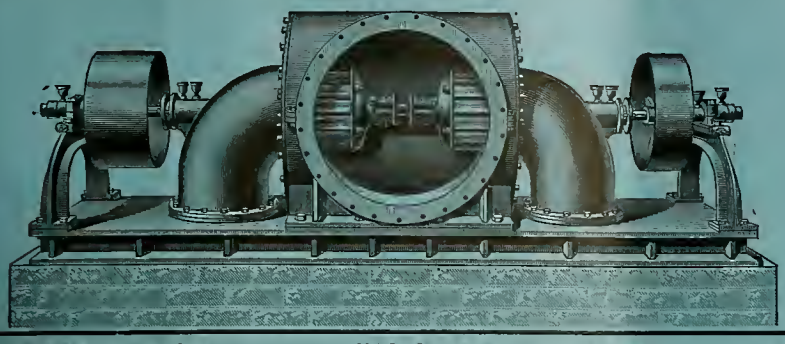

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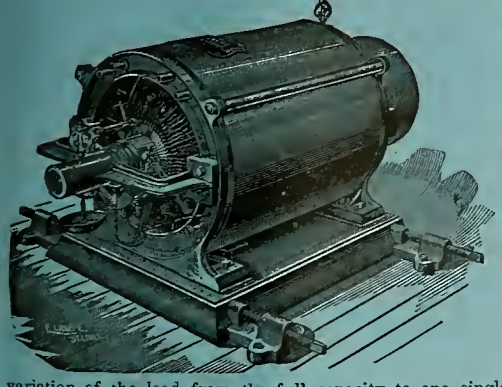

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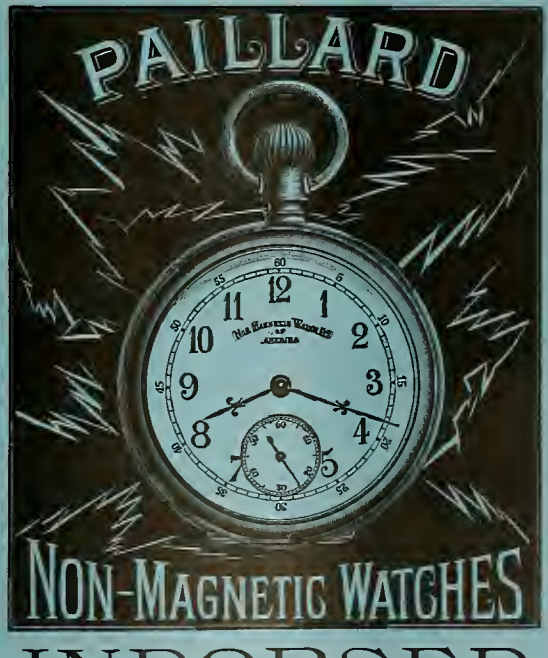

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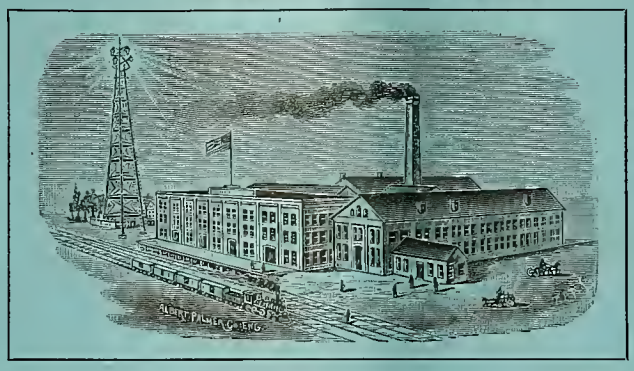

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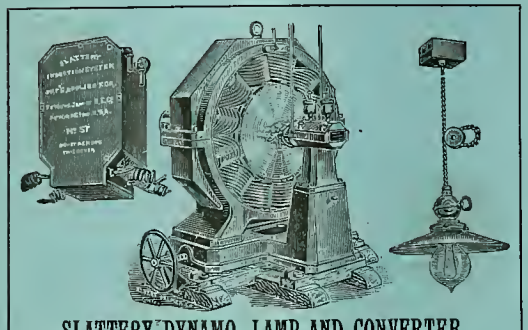

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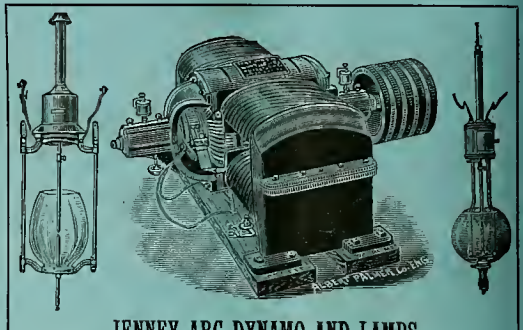

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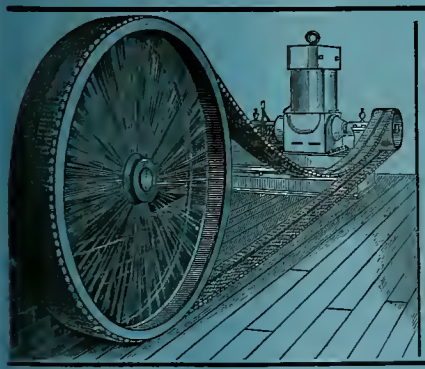

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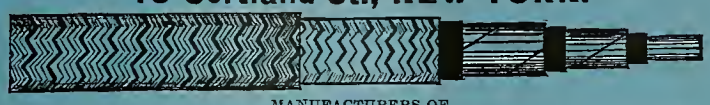

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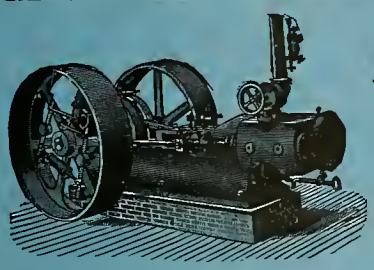

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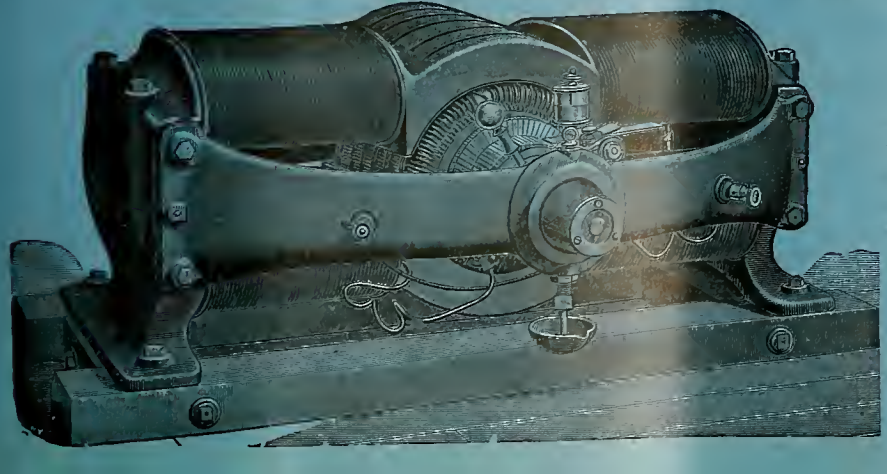

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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

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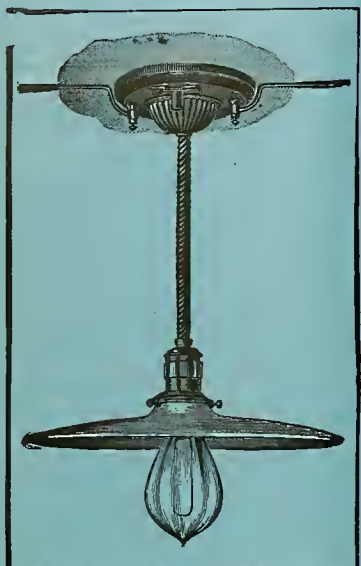

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These Lamps have repeatedly shown their superiority under test.

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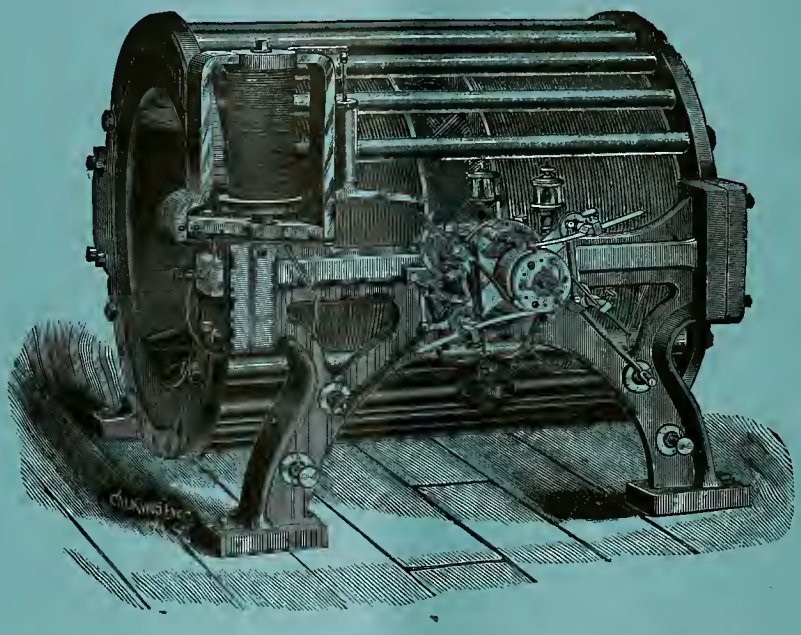
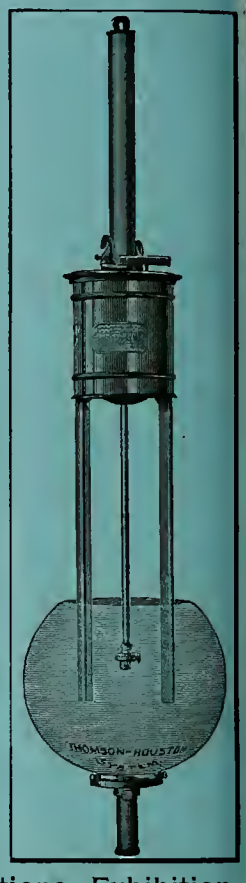
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.





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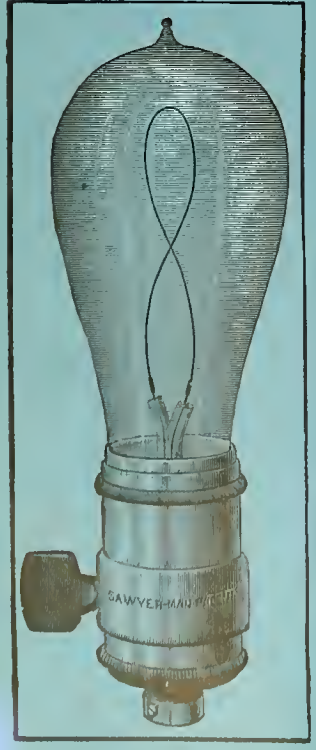
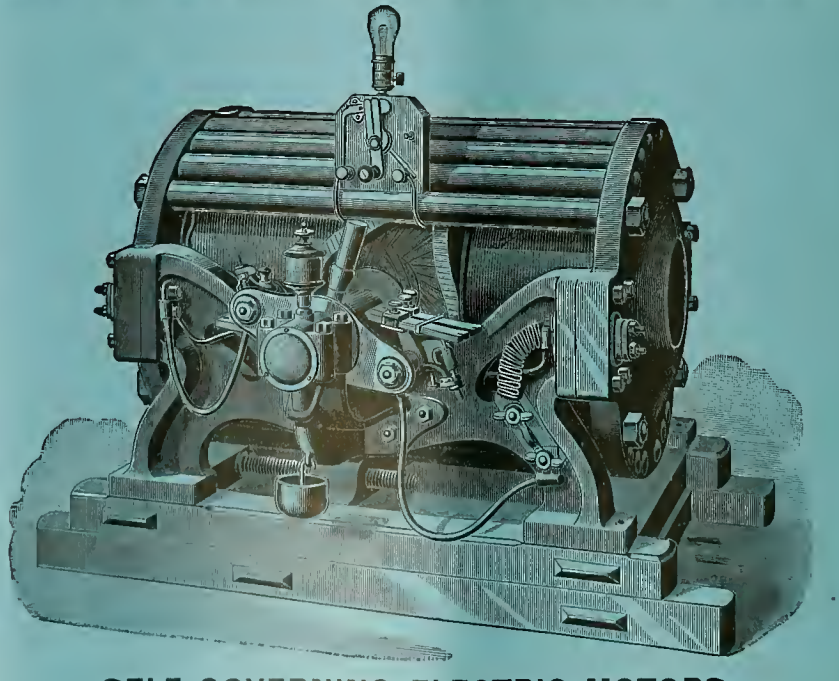
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

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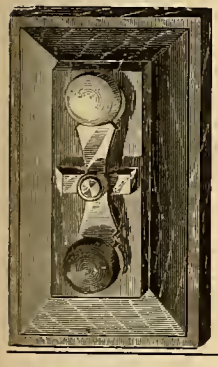

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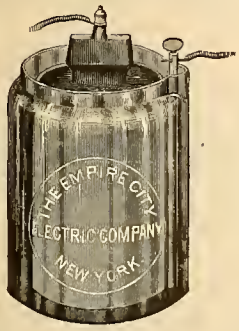

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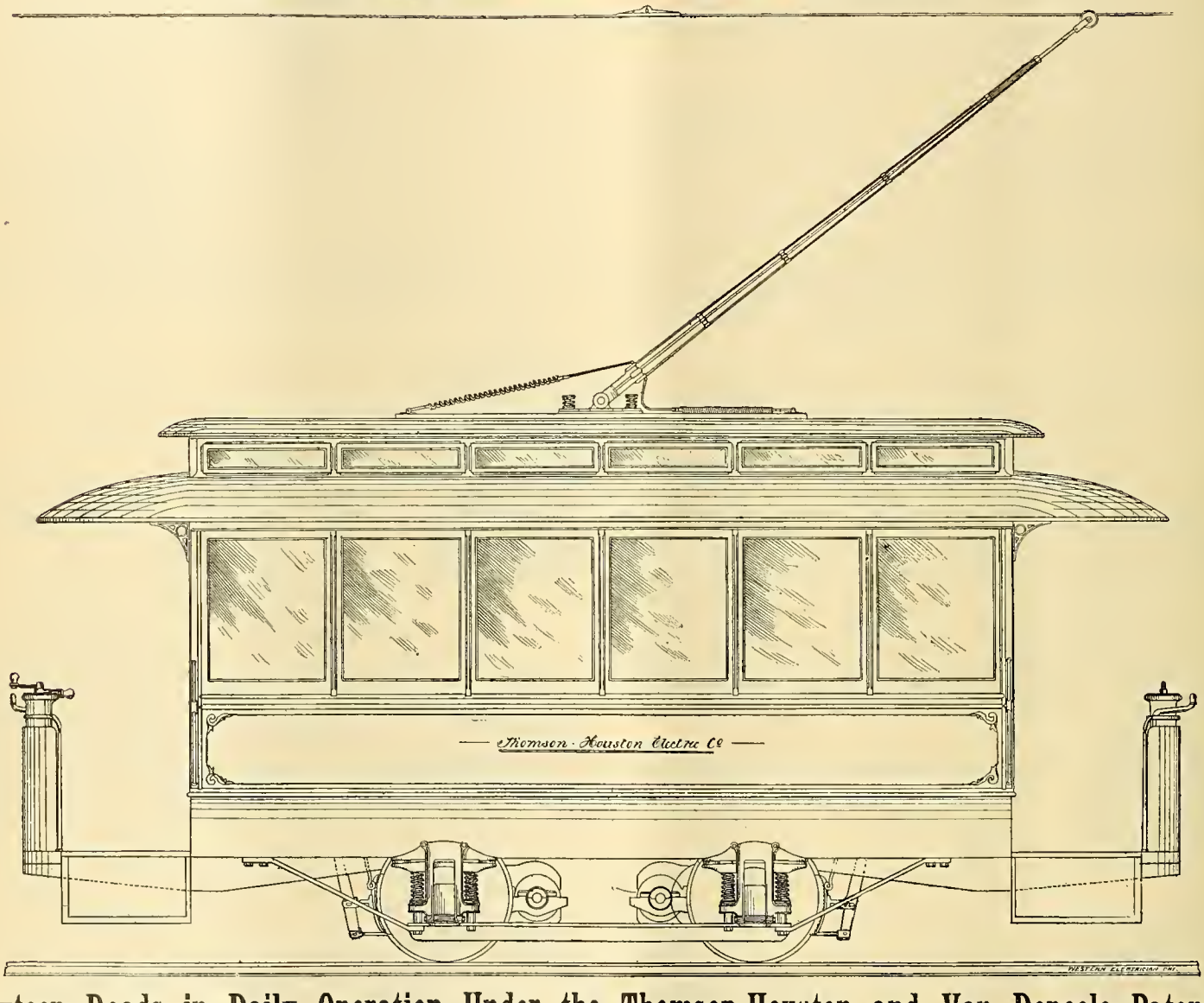

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The installment of over 100 Central Station Plants has demonstrated the Alternating Transformer System to be superior to all others, for distributing current from a Central Station over small or large areas for lighting and power purposes.

ALTERNATING CURRENT METERS.

This system is made more profitable than any other by the use of the meter now supplied by this company.

It measures the whole current.

It is strictly a positive mechanical movement.

It registers directly in lamp hours.

It reads from dials like a gas meter.

It consumes no appreciable energy.

It is not affected by temperature or other local conditions.

It is practical, and it is cheap.

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This company has demonstrated that motors run by the alternating current are as efficient as the best direct current motors, and can be run without commutators or brushes, being started, stopped and reversed without breaking a connection.

All parties desiring to secure the most perfect system of electric distribution for light and power are invited to inspect the apparatus at the works of the company at Pittsburgh, Pa., where it will be demonstrated that the Alternating System possesses such advantages over the direct system in regard to efficiency, distribution, safety, life of lamps, and the use of meters and motors, that no purchaser can afford, at any price, to take the direct current apparatus.

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Western Electrician.

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Vol. III. CHICAGO, OCTOBER 13, 1888. No. 15.

Electrical Housework Novelties.

The Novelty Electric company of Philadelphia has recently placed on the market several new designs of goods for housework, shown by the accompanying cuts.

Figs. 1 and 2 represent the exterior and interior of a new trunnion bell. The woodwork is made in a variety of fine woods, elegantly finished and highly polished, while the working parts are superior in workmanship. The armature works upon trunnion points, and the adjustment is delicately accomplished by means of a spiral tension spring and thumb-nut. The magnets are silk wound on rubber head spools. This bell is designed for a fine class of work, and not for competition with cheap bells.

Figs. 3 and 4 are new designs of pendant pushes. The push itself is of pearl. These pushes are made in many kinds of wood, and are highly finished.

Figs. 5 and 6 represent the exterior and interior of continuous ringing attachment. The metal case is nickel-plated. When put in the circuit of an ordinary vibrating electric bell, this attachment makes the bell ring continuously when pressure is put upon the push button. The turning of the knob on the outside of the case, bringing the arrow to a perpendicular position, stops the ringing of the bell. For an electric door bell this attachment is a valuable acquisition. It is placed inside of a vestibule door in circuit with the bell in the kitchen, which continues to ring, when the front door push is pressed, until the servant goes to the door and throws open the connection by turning the knob.

Figs. 7 and 8 are novel designs of automatic lighting keys made of mahogany, walnut, ash or oak, handsomely polished. These are entirely different in appearance from any of the standard keys upon the market.

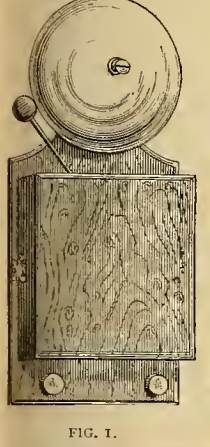


FIG. 1.

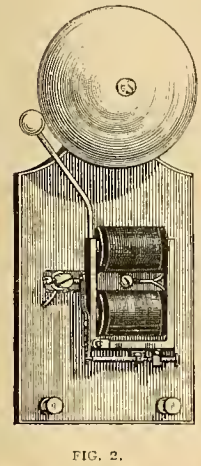


FIG. 2.

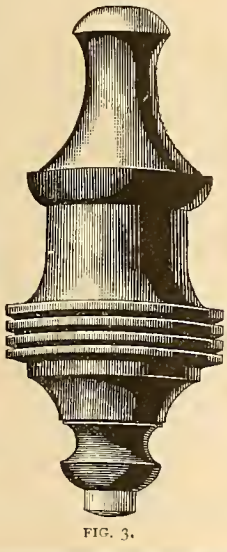


FIG. 3.

FIG. 4.

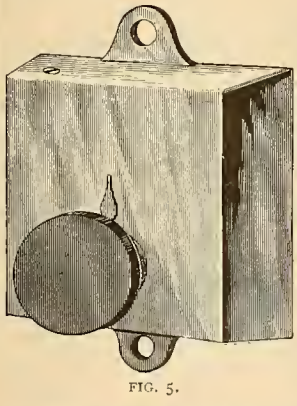


FIG. 5.

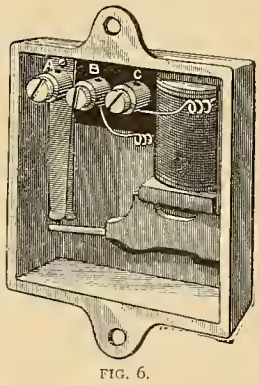


FIG. 6.

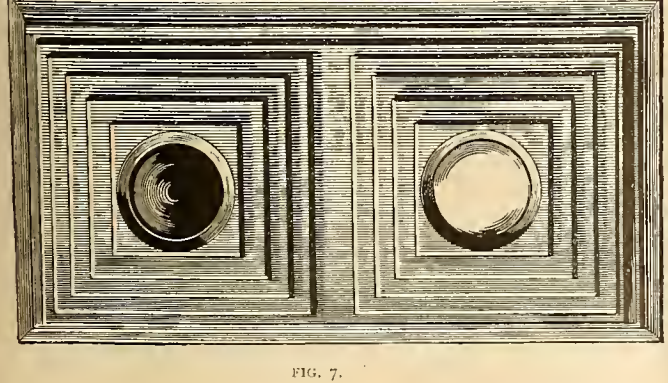


FIG. 7.

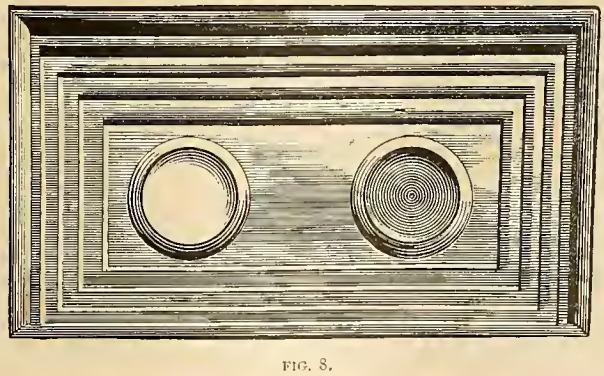


FIG. 8.

A New Meterage System[1]

By W. Lowrie.

The supply of electricity from central stations has for years received a large amount of attention, but till within quite recently a practical house-to-house supply was impossible, owing to the enormous weight and cost of the copper conductors or mains required to convey large currents at low tensions to any considerable distance. The sectional area had to be very great to avoid a high percentage of loss due to resistance. This objection, which was fatal to any extensive venture in a house-to-house supply of electricity, has now been overcome by the introduction of the high tension alternating current, and secondary generator or converter system. By the employment of this system, the current is so greatly reduced, and therefore, the size of the mains is so lessened, that even in very long distances any loss due to their resistance may be reduced to a practical minimum without any serious outlay of capital.

One of the most important features in a house-to-house supply of electricity is a reliable method of meterage to the different consumers; now even in the case of the old systems of low tension continuous current circuits, the difficulties of meterage have, hitherto, not been satisfactorily overcome. The greatest difficulty in these systems is the very high percentage of loss due to the passage of very large currents through the resistance offered them by the coils or other mechanical appliances which have to be introduced into the circuit, rendering it impossible to obtain the regular and full luminosity of the lamps. Or in the case of an electro-deposition-meter, the enormous quantity of copper carried from plate to plate, and consequently, their large area and thickness, and also the difficulties connected with the accurate weighing of these very heavy plates, are insurmountable objections. Still more difficult has it been considered to meter alternating currents, for they will neither deposit metals nor decompose liquids, and in any attempt that is made to construct a mechanical meter, retardation is set up against the current, to so great an extent, in the coil or coils necessary to control or act as a motive power to the suitable mechanism, that here again insurmountable objections are met with. But it is the very fact of this inability of the alternating current to deposit metals or decompose liquids, which has hitherto been considered fatal to any sys-

[1] Read before the British Association September 10, 1888.

tem of meterage, which enabled Lowrie, Hall and Kolle, the inventors of the new system herein described, to form a most efficient and reliable method of electro-deposition meterage.

This new system is the differentiation of the main or alternating electromotive force. This desired effect can be brought about in many ways. The one used now by Lowrie & Hall, in their house-to-house lighting system at Eastbourne, depends upon the introduction of a constant electromotive force into the said main or alternating circuit, which, while it reinforces the main electromotive force in the half alternation in a direction positive to it, retards it in that direction which is negative to it; so producing a subsidiary or resultant extra current to the main or alternation current in that half alternation which is positive to the constant electro-

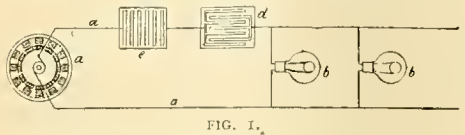


FIG. 1.

motive force. This subsidiary current must be necessarily exactly proportional to the main current, or what is the same thing, to the resistance of those appliances in which the electric energy is expended. Thus, by putting a deposition cell in series with the source of the constant electromotive force, the amount of deposit will become available as a current measure. So that the fact of the current being an alternating one allows the use of a deposition cell when the addition of a constant electromotive force has been made, for where, as before pointed out, with a continuous current the passage of copper would be excessively large, by the application of this invention to an alternating current, this passage may be reduced to a minimum, so long as it remains sufficient for a practical measurement, for this

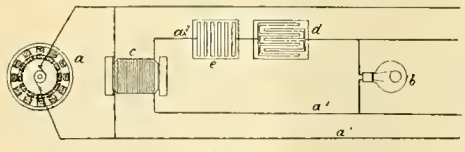


FIG. 2.

said passage depends alone on the magnitude of the subsidiary electromotive force.

Having now described their method of obtaining an alternating current in which the maximum current in one-half of an alternation is greater than that in the other half in the opposite direction, we will describe the practical method of obtaining from it the efficient method of meterage at present adopted by Lowrie & Hall, and to give a detailed description of the appliances and also the methods of obtaining constants, etc., and other matters appertaining thereunto.

The main *M M* is severed as it proceeds directly from the dynamo, converter, or other source of electrical energy to the lamps or other appliances in which the energy is expended, and the meter put across the brake, so that the entire current, which has to be metered,

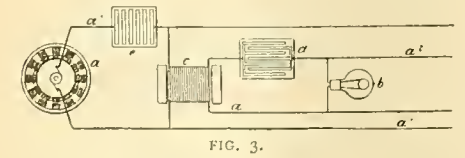


FIG. 3.

passes directly through it. The current on entering the meter passes through the secondary cell, *E*, whose electromotive force = 2 volts, so producing the necessary differentiation in the positive and negative directions in half of an alternation. That is to say, that supposing the electromotive force of the dynamo or converter to be 100 volts, and the main current to be 10 amperes. Then in the half alternation positive to the constant cell at its maximum point, the total electromotive force =202 volts, and therefore the maximum current = 202 ÷ 10 = 20.2 amperes. While in the other half alternation, the total resultant electromotive force = 198 volts, the current = 198 ÷ 10 = 19.8 amperes, so giving an effective current of .4 amperes. But this current lasts for only one-half of an alternation, in the same way that an alternating current does in consequence of its necessary fall from its maximum positive point to a neutral point, in order to rise to its maximum negative point; so that, although at its maximum point, the effective current = .4 amperes. Yet its average current

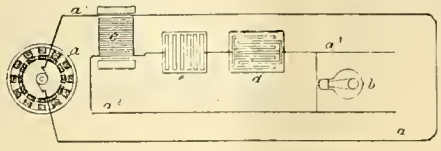


FIG. 4.

is only .2 amperes for all the time, or, which is the same thing, a current due to 2 volts only. So, it is evident that the resultant current may be considered as one merely resulting from 2 volts constantly acting through the circuit resistance. The application of this effective current takes place in the depositing cell, *D*, which is a cell in which the electrodes are of copper, alternately connected together; and the solution a slightly acidulated saturated solution of recrystallized sulphate of copper in distilled water.

The meter exhibited is one for a 20 sixteen candle power 100 volt lamp installation, or for a maximum current of 12 amperes; the area of the plates is 48 square inches, giving an area of 4

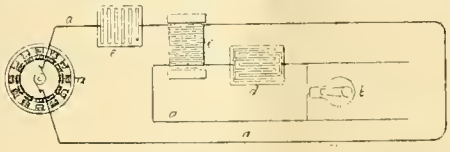


FIG. 5.

square inches per ampere, which, with the strong solution used, gives a resistance quite negligible. The capacity of the secondary cell is to register 400 units without recharging. The drawing shows the details of a 40-light meter. The depositing cell is composed of an alloy unacted upon by the solution; the plates, *P P*, *p p*, are kept at equal distances by the distance pieces, *N N*; by which, also, the connections are made between the alternate plates, *P P*, a like connection being made by similar distance pieces, which are not shown in the drawing, between the alternate plates, *p p*. They are also kept at equal distances by the slots in the vulcanite pieces, *Q*, *Q*, supported by the metal bridges, *R*, *R*, the exterior sides of the plates being coated with an insulating enamel, so that no deposition can take place upon them. By an examination

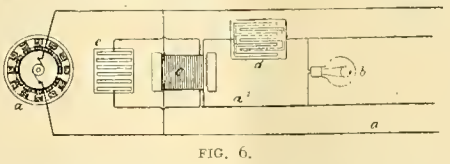


FIG. 6.

of the drawing the very simple method of removing the plates for weighing purposes, without danger of injuring the deposit, will be seen, their removal being effected by releasing the nuts at the ends of the distance pieces, and the plates slid out. The whole is contained in the cast iron case, *S*, with the cover screwed down by the screws, *T*, *T*, the cables entering through the insulating washers, *U*, *U*, the insulation of the secondary cell from the containing case being effected by the insulating frame, *W*, *W*.

To obtain the constants in the constant electromotive force and depositing cell system, take, for example, an electric lighting circuit, with an electromotive force of 100 volts, and for a constant source of electromotive force a secondary cell of an electromotive force of 2 volts. Then within an alteration in a positive direction to the cell the total e. m f.=102 volts; and in a nega-

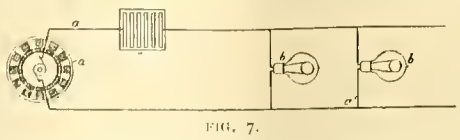


FIG. 7.

tive direction the resultant e. m. f.=98 volts; so giving a difference of potential of 4 volts for half the time of an alternation, as before explained. Therefore, in so far as the chemical action is concerned, the electromotive force of the cell, *i. e.*, 2 volts, may be considered as working constantly through the resistance of the lamps. From this the constants of grammes per unit or units per gramme are easily arrived at. Thus, in a 100 volt circuit with 10 amperes flowing the work = 1,000 watts; and since the resistance of exterior circuit = 10 ohms, therefore the subsidiary current from the secondary cell 2 ÷ 10 = .2 amperes. Therefore the effective quantity of electricity passing through the electrolyte, with 1,000 watts in exterior circuit, for 1 hour (*i. e.*, 1 unit) = .2 × 3,600 = 720 coulombs. Consequently the constant for a copper deposition meter is, during 1 unit of exterior work, 720 × .000327 = .23544 grammes of copper are deposited. The requisite capacity of the secondary cell is only one-half that of the capacity calculated from the number of ampere-hours re-

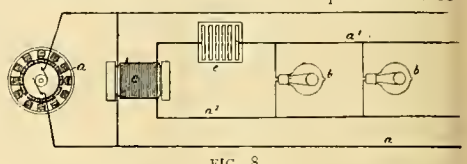


FIG. 8.

quired to deposit the copper. The discharging current, when the current is positive to the cell, is that resulting from 4 volts, for half an alternation, more than 98 volts (*i. e.*, 2 volts from the cell + 2 volts from the dynamo); and on the negative alternation the cell is charged resulting from an e. m. f. of 98 volts. Thus the charge of the dynamo neutralizes the discharge, so leaving a 2-volts discharge for only one-half the time.

Given pure copper sulphate and distilled water, and good copper, it is obvious that the meter must be absolutely accurate. But in consequence of slight impurities which must necessarily occur, an error, certainly of not more than 2 per cent., may be deducted, so giving an accuracy, under ordinary conditions, of at least 98 per cent.

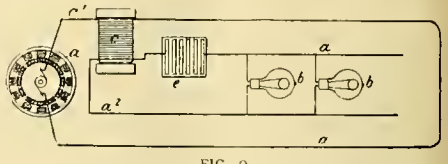


FIG. 9.

The use of copper in the depositing cells is quite optional, as any metal and solution may be used, by which any practical electro-deposition may be obtained; copper, however, is considered at present, by the inventors to be the most convenient and cheapest electrode.

Various forms of self-reading or self-recording depositing cells are made, the usual form being a dial pattern, the needle of which is actuated by the alterations of the weights of the electrodes.

Another form is that of a gas meter in which the electrolyte is decomposed by the passage of the subsidiary current, a graduated gauge-glass

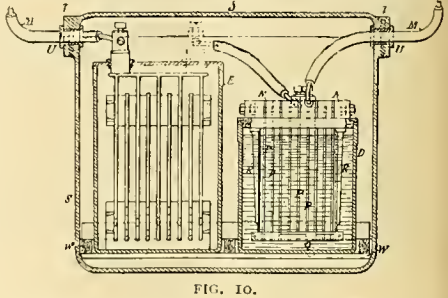


FIG. 10.

enabling a consumer to see approximately what his consumption may have been.

In the diagrams in connection, *a* indicates the generator; a^1, the main circuit; a^2, the secondary circuit; *b*, the lamps or other appliances in which the electrical energy is expended; *c*, the secondary generator or converter; *d*, the depositing cell; *e*, a constant electromotive force.

Fig. 1. This is the diagram of an electric lighting circuit, coupled directly in parallel with the dynamo, as in the old low tension system, with a constant electromotive force, *e*, and the depositing cell, *d*, placed in the circuit, so that all the current which is to be measured passes through them. The differential action of the current causes an electro deposition of metal by

the influence of the electromotive force, *e*, on the alternating or main electromotive force, which, being exactly proportional to the amount of electricity passed through *b*, becomes a measure of the same, as before described.

Fig. 2. This is a diagram of a secondary generator or converter system, in which the primary and secondary circuits are coupled in parallel, the primary circuit, a^1, including currents in the secondary circuit, a^2, by means of a converter, *c*. The depositing cell, *d*, and the constant electromotive force, *e*, are placed in the secondary circuit, a^2, thus becoming a measure of current, as before described in relation to Fig. 1.

In a secondary generator or converter system the secondary cell may be introduced into either the primary or secondary circuit, the depositing cell being, in all cases, between the secondary coil of the converter and the apparatus in which the electrical energy is expended.

Fig. 3. This is also a parallel secondary generator or converter system, in which the electromotive force, *e*, is placed in the primary circuit, a^1, and the deposition cell, *d*, is placed in the secondary circuit, a^2. The differentiation of the electromotive force produced by the constant electromotive force, *e*, in the primary circuit, a^1, is reproduced by induction in the secondary circuit, a^2, by means of the converter, *c*. Electro deposition results in the depositing cell, as before described.

Fig. 4. This diagram indicates one of several converters; *c* may be placed in series in the primary circuit, a^1. This induces currents in the secondary circuits, a^2, arranged in parallel with the appliances in which is expended the electrical energy. Both the constant electromotive force, *e*, and the deposition cell, *d*, are placed in the said secondary circuit, and thus become a measure for the electricity passed, as described in the preceding figures, in each individual secondary circuit.

Fig. 5. This is also a series secondary generator or converter system, having the constant electromotive force, *e*, in the primary circuit, a^1, and the depositing cell, *d*, in each individual secondary circuit, a^2. The same differentiation of the electromotive force produced by *e* being reproduced by induction in the secondary circuits, a^2, by the converter, *c*, as hitherto described in connection with Fig. 3.

Fig. 6. This is a parallel converter system, the constant electromotive force, *e*, in this case is used in a separate winding of the converter, *c*. This, in combination with the primary circuit, a^1, produces by induction, in the converter itself, the differentiated current in the secondary circuit, a^2, electro deposition resulting in the depositing cell, *d*, as described previously in connection with Fig. 3. We may mention that to obtain this differentiation, instead of a secondary cell, a primary cell, or a dynamo may be used, or any other means of obtaining the desired effect.

The following is an example of another method of meterage and apparatus connected therewith, operating in the manner above-mentioned, but using no deposition cell, the measurement being taken in the constant electromotive force cell itself.

Let it be required to measure the current duration of a number of lamps in a lighting circuit. We place in the lamp circuit, and in series between it and the generator, an electrolytic cell, which comprises two dissimilar metals, placed in an acid or alkaline solution.

When an alternating current is passed through this cell and the lamp circuit, the passage or flow of the current is alternately retarded or reinforced by the normal electromotive force set up in the cell itself; which subsidiary electromotive force causes a wasting or loss of weight of the positive electrode. As the resistance of the lamps in the lamp circuit varies, according to the number and kind used, and the duration of the flow of current through the same, so does the current vary in the cell which acts upon the positive electrode.

This current is directly proportional to the electromotive force of the cell and the resistance of the lamp circuit; the wasting away of the positive electrode, therefore, becomes available as a current meter.

Fig. 7. This is a diagram of a similar low tension circuit to that described in Fig. 1, but without the deposition cell, *d*. In this arrangement one of the electrodes of the constant electromotive force, *e*, loses weight proportional to the electricity passed through the lamp circuit, *b*, and this loss becomes a measure of the same, as before described.

Fig. 8. This is a diagram of a similar secondary generator or converter system as that described in Fig. 2, but without the deposition cell, *d*. The electromotive force, *e*, in the secondary circuit, a^2, has one electric losing weight in the same manner as before described in the example of a low tension system given in Fig. 7.

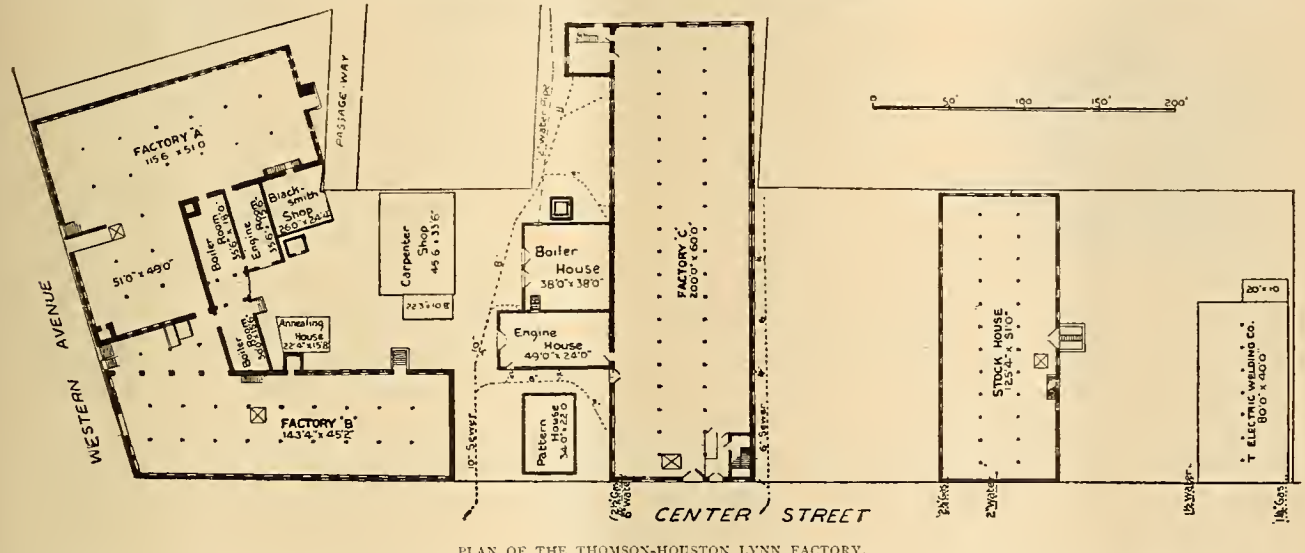
Fig. 9. This is another series converter system similar to that described in Fig. 5, but without the depositing cell, *d*, the measurements being, in this case, obtained by the wasting away or deposition of the metal forming the electrodes of the cell, *e*, producing the constant electromotive force which causes the differentiation, as described in relation to Fig. 7.

This differentiation may also be produced by mechanical means. One of these is the addition of subsidiary coils upon the armature of the alternating dynamo, which is so arranged and commuted that it is cut out of the circuit during the second half of an alternation; or it may be so commuted that in the second half of the alternation its electromotive force is in the opposite direction to that of the dynamo—so giving double the differentiation of potential that it would in the other case. The current is commuted at the neutral point of the alternation, so that no high tension break occurs at any time.

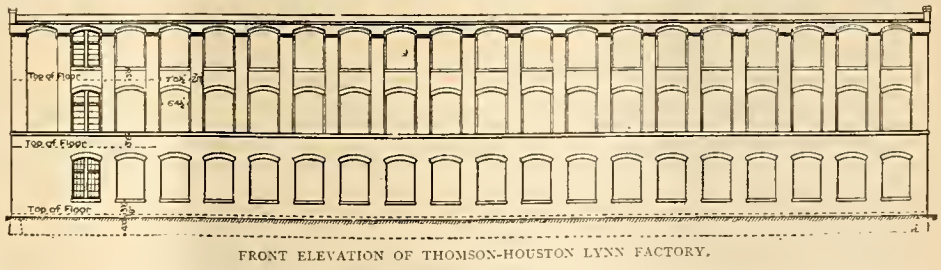
Another method is to pass the alternating current through a coil having a magnetically saturated iron core, the result being that in the half alternation positive to the direction of the exciting current, no retardation takes place, while that in the negative direction is retarded. To this latter method that described in Fig. 6 more properly belongs, except that in that case the exciting current is from the constant electromotive force, *e*, round the separate winding on the iron of the converter, instead of round a separate coil having an iron core.

In a secondary generator or converter system, where differentiation is effected by these means, the same differentiation is reproduced by induction, and an electrolytic cell, or other means of measurement, is put in direct series between the converter and those appliances in which the electrical energy is expended.

This also can be applied in the Figs. 1 to 5, the arrangements described being substituted for the constant electromotive force, *e*.



PLAN OF THE THOMSON-HOUSTON LYNN FACTORY.



FRONT ELEVATION OF THOMSON-HOUSTON LYNN FACTORY.

The Thomson-Houston Lynn Factory.

There can be no doubt that there is at present no business in which there has been so much remarkable development in the past year as that of the manufacture of electrical apparatus for lighting and the electrical transmission of power, and no company has shown so marked a progress in the manufacture of new and improved machinery as the Thomson-Houston Electric company of Lynn, Mass., says *Progressive Age*. This company was organized in 1880, and occupied a small factory in New Britain, Conn., employing but few hands. It now occupies the finest and best equipped factory in the world for the production of electrical apparatus, and employs 1,000 men and 200 girls and women. Its present factory in Lynn was built in 1883, and consists of three four-story brick buildings, having a floor space of about 128,865 square feet, or nearly three acres, and is thoroughly lighted by 275 arc and 1,200 incandescent lamps.

The basement of factory A is devoted to the making of fields for the arc light dynamo, and is well equipped with lathes and planers especially adapted to heavy work. After the machine work on the fields has been done they are

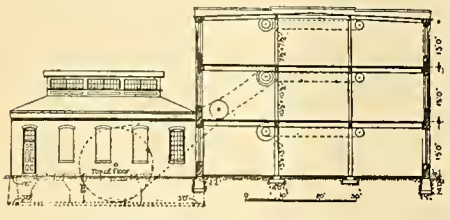
taken to the third floor of factory A, where the winding is done. A part of this floor is also devoted to the winding of regulators and magnets for arc lamps, necessitating for both classes of this work the employment of about 100 men. Adjacent to the machine shop on the lower floor is the arc dynamo testing room, which is equipped with a floor counter-shaft driven by a 90 horse power Corliss engine. Before leaving the factory every arc dynamo is sent to this room and tested from twenty to thirty hours.

On the lower floor of factory A are the baking ovens where the armatures are taken as they come from the winding department, and by means of electric current and steam heat are completely dried. One portion of this floor also is occupied by a lighting plant, twenty dynamos in number, which furnish light for the factory and the current used in the manufacturing of incandescent lamps. The remainder of this floor is used for the setting up and testing of incandescent dynamos. Closely adjoining this room is the boiler house, which is equipped with

ENGINE HOUSE AND CROSS-SECTION, FACTORY.

two 100 horse power boilers which furnish steam for a 250 horse power engine for factory B, and three 60 horse power boilers which supply steam to the engine for factory A, and the dynamo testing room. The second floor of factory B is the arc lamp department, and is equipped with special machinery for making various parts of the standard lamp. The next room to this one is used for testing arc lamps. This is provided with a large switch-board, which controls the current on each row of lamps. There are ten rows, seventeen lamps in each, separated by short suspended partitions painted black to diminish the glare and facilitate the examination of carbon points. Adjoining is the packing and shipping department, where all the dynamos, lamps and other appliances are boxed and delivered to the teams.

A part of the second floor of factory A is used for sheet metal work, aad adjoining is a small machine shop where jigs and special tools are made. On the opposite side from the packing room is the supply department, where all the material brought into the factory is taken, and



ELEVATION OF FACTORY C.

adjoining it is a finished stock room and inspection department, where every piece of finished apparatus is carefully examined before it leaves the factory. The general offices include a large drafting room, Superintendent Rice's office, library or reference room for electrical books and periodicals, Professor Thomson's private laboratory and experimental shops.

The incandescent lamp department occupies the third floor of factory B, where 125 women and girls are employed, and this is fitted up with all the appliances necessary for the manufacture of a superior incandescent lamp. The incandescent lamp testing room is on the third floor of factory A, and has a capacity of testing 1,000 lamps at a time, and also 100 series lamps. The next department is a special machine testing room, and adjoining is a general instrument room where all the fine measurements are made.

In the rear of factories A and B is the new boiler room and engine house for factory C. This contains two 125 horse power boilers, supplying steam to a double Green engine of 500 horse power. This engine has 20-inch cylinders and 42-inch stroke, and a fly-wheel 20 feet in diameter, weighing 18½ tons. The engine runs 100 revolutions per minute at 80 pounds' pressure. The ground floor of factory C is used for the manufacture of the heavy parts of railway and stationary motors. The second and third floors are devoted to the manufacture of the small parts of motors, lightning arresters, transformers and alternating current dynamos. Beyond factory C is a large stone house, a storehouse for patterns, and a building devoted to electric welding. In spite of the fact that the company has such large quarters it has been found necessary to erect two new buildings, now in process of construction, which will be devoted exclusively to electric railway work, the phenomenal increase in the business of this department making this necessary.

Bell Hangers' Hand-Book.[1]

By F. B. Badt.

PART I.

VOLTAIC ELECTRICITY.

Chapter I.

Contact Series.

Two dissimilar metals brought in contact produce opposite kinds of electricity on the two surfaces, one becoming positively (+) and the other negatively (−) electrified.

In the following table metals are arranged in such a series that each becomes positively electrified when placed in contact with one below it:

Contact Series of Metals in Air.—

Positive (+)

Sodium
Magnesium
Zinc
Lead
Tin
Iron
Copper
Silver
Gold
Platinum
Graphite (carbon.)

Negative (−)

Chapter II.

The Voltaic or Galvanic Cell.

To make a simple voltaic or galvanic cell, place in a glass jar water, acidulated with a few drops of sulphuric acid, a strip of zinc, and a strip of copper. This cell is capable of generating a continuous flow of electricity through a wire, whose ends are connected to the two metal strips. See Fig. 1.

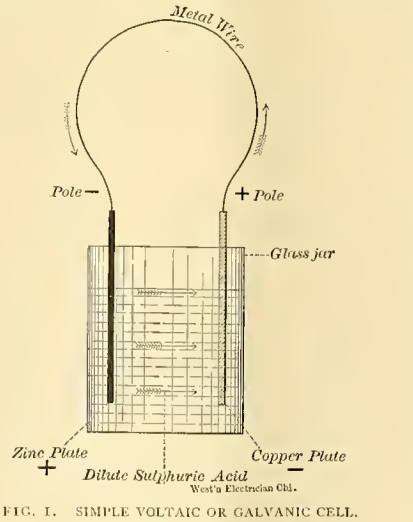


FIG. 1. SIMPLE VOLTAIC OR GALVANIC CELL.

Chapter III.

Generation of Current.

The current in such a cell, as shown in Fig. 1, starts from the positive zinc plate, flows through the fluid to the copper plate, out through the external circuit and back to the zinc plate. The copper strip, whence the current starts on its journey through the *external* circuit, is called the *positive pole* (+) and the zinc strip is called the *negative pole* (−). When the external circuit is broken no current flows, but still the wire connected to the positive pole (copper plate) is called the positive wire, and the wire connected to the zinc pole the negative wire. As in almost all commercial batteries zinc is used as one pole, it may be well to remember that the *zinc pole* is always the *negative pole*.

When the current flows the zinc strip is observed to waste away. Its consumption furnishes the energy required to drive the current through the fluid from zinc to copper, and through the external circuit. At the same time it will be noticed that a few bubbles of hydrogen gas appear on the surface of the copper plate. Both these actions go on as long as the wires are joined to form a complete circuit. Thus the production of an electric current by a voltaic cell is always accompanied by chemical action in the cell. Zinc and the other metals which stand at the electro-positive end of the contact-series will be dissolved, while the electro-negative substances—copper, silver, gold, platinum and graphite—will not be attacked.

A piece of quite pure zinc when dipped alone into dilute sulphuric acid is not attacked by the liquid. The ordinary commercial zinc, however, is not pure and will be dissolved, a large quantity of hydrogen bubbles being given off from the surface of the metal.

As shown before, when the current flows through the cell and chemical action commences, the bubbles of hydrogen are evolved not at the zinc plate, nor throughout the liquid, but at the surface of the copper plate. This apparent transfer of the hydrogen gas through the liquid from the zinc to the surface of the copper plate must be borne in mind to understand the action of the different voltaic cells.

Chapter IV.

Local Action.

When the circuit is not closed, the current cannot flow and there should be no chemical action. The impure zinc of commerce, however, will continuously dissolve in the acid and give off hydrogen bubbles. This is called local action. It is caused by impurities in the zinc, such as particles of iron or other metals which behave in contact with the particles of zinc and the acid like miniature voltaic cells, and thus cause a constant waste of the zinc even if the battery circuit should be open.

To do away with this local action the zinc plates are amalgamated. The iron particles do not dissolve in the mercury, but are carried off from the surface of the zinc plate by the hydrogen bubbles. As the zinc in the amalgam dissolves the film of mercury unites with fresh portions of zinc, and consequently always presents a clean, bright surface to the liquid. The amalgamation of the zinc plates may be very well done by first immersing the zincs in a solution of dilute sulphuric acid and then in a bath of mercury. A brush or cloth may be used to rub them, so as to reach all points of the surface. Where a large number of zincs is to be amalgamated, the following will be found to be a good method: Dissolve eight ounces of mercury in a mixture consisting of two pounds of hydrochloric and one pound of nitric acid; when the solution is complete, add three pounds of hydrochloric acid. The zincs are amalgamated by immersing them in this solution for a few seconds; they should then be removed to a vat of clear water and rubbed as in the first case with a brush or cloth. If the solution is kept in a covered vessel it may be used a number of times.

Chapter V.

Polarization.

The bubbles of hydrogen liberated at the surface of the copper electrode stick to it in great numbers, and form a film over its surface; hence the effective amount of service of the plate is very much diminished in a short time. This will cause an immediate falling off in the strength of the current, sometimes even stopping it entirely. A battery in this condition is said to be polarized. The effects of polarization are: First, it weakens the current by the increased resistance which it offers to the flow, for bubbles of gas are bad conductors; and secondly it weakens the current by setting up an opposing electromotive force, for hydrogen is nearly as oxydizable as zinc, and is electro positive.

It is, of course, very important to prevent this polarization, as otherwise the current would not be constant.

Various remedies are employed. These may be classed as mechanical, chemical and electro chemical.

1. *Mechanical Means.*—The liquid may be agitated or air may be blown through it, thus preventing the hydrogen bubbles from sticking to the positive pole.

The surface of the latter may be roughened so the bubbles will collect at the points and be quickly carried off. Example: Smee's cell.

2. *Chemical Means.* - If a highly oxydizing substance be added to the acid, it will prevent the formation of hydrogen bubbles, as the oxygen of this substance will combine with the hydrogen and from water. Such substances are bichromate of potash, binoxide of manganese, nitric acid, and chloride of lime. These substances, however, would attack the copper, and they can only be used in zinc-carbon or zinc-platinum cells. Nitric acid also attacks zinc when the circuit is open and cannot be employed in the same single cell with the zinc plate. Examples of cells: Grenet, Grove, Bunsen, carbon, nickel plating, Fuller, Leclanche, diamond carbon.

3. *Electro Chemical Means.*—Double cells can be arranged in such manner that a solid metal such as copper shall be liberated instead of hydrogen bubbles. This entirely prevents polarization. Examples of cells: Daniell, gravity.

A battery to be really good should fulfill the following conditions:

Its electromotive force should be high and constant.

Its internal resistance should be small.

It should give a constant current and must therefore be free from polarization, and not liable to rapid exhaustion requiring frequent renewal of material.

It should consume no material when the circuit is open.

It should be cheap, and of durable materials.

It should be manageable and if possible, should not emit corrosive fumes.

No single battery fulfills all these conditions, however; some batteries are better for one purpose and some for another. Thus, for telegraphing through a long line of wire, a considerable internal resistance is of no great consequence, as it is but a small fraction of the total resistance in circuit.

[1] Bell Hangers' Hand-Book, by F. B. Badt; in course of preparation; about 100 pages, 80 illustrations; flexible cloth binding; type page 6 inches by 3 inches; price $1. All rights reserved.

For electric gas lighting or other low resistance circuits, on the other hand, much internal resistance would be, if not absolutely fatal, certainly a positive disadvantage.

CHAPTER VI.

Classification of Cells.

According to the foregoing voltaic cells may be classified as single fluid and two fluid cells or batteries.

Following are descriptions of the leading representatives of these two classes:

SINGLE FLUID BATTERIES.

CHAPTER VII.

The Smee Battery.

This cell Fig. 2, is an improvement on the simple volta-zinc-copper cell; it consists of two zinc plates, forming one pole, and one platinized silver plate the other pole, both dipping into dilute sulphuric acid. The polarization of this one-fluid battery is avoided by rough-coating the silver plate with finely divided platinum, which liberates the hydrogen bubbles freely; nevertheless, the current would fall off greatly after closing the battery for a few minutes. This battery is charged with a solution of one part sulphuric acid to seven of water. The plates are connected to the clamp and placed in the jar. In this battery, above all the pre-

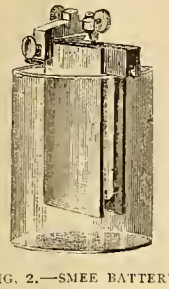


FIG. 2.—SMEE BATTERY.

caution of amalgamating the zinc should never be neglected. With an unamalgamated zinc the results are very unsatisfactory.

CHAPTER VIII.

The Grenet Battery.

The glass jar of this cell is generally made in the shape of a bottle. A well amalgamated plate of zinc forms one pole, and a pair of carbon plates, one on each side of the zinc, joined at the hard rubber top, forms the other pole. In Fig. 3, the carbon plates are marked C and the zinc plate Z. The bottle is filled with bichromate of potash and dilute sulphuric acid. [See electropoion fluid.] As this solution acts on the zinc when the circuit is open the zinc plate is fixed to a brass rod, by which it can be drawn up out of the solution when the cell is not in use It is almost the only single-fluid cell free from polarization, and even in this form the strength of the current falls off after a few minutes' use, owing to the chemical reduction of the liquid.

This battery is especially adapted for experimental and illustrative purposes. It occupies but little space, furnishes a great quantity of current, and, as the zinc can be raised from the fluid, may be kept charged, ready for use, for many months, and can be set in action any time when required by simply depressing the brass rod which slides through the center of the cover of the cell, and to which the zinc is attached. For operating induction coils, which are frequently used for electric gas lighting, and for heating effects in medical practice, it is unequaled.

The battery is charged by pouring electropoion fluid into the cell until it reaches nearly to the top of the globular part, and then drawing up the zinc and placing the element

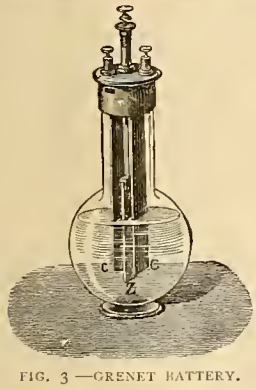


FIG. 3 —GRENET BATTERY.

in the cell The fluid should not be so high as to touch the zinc when the latter is drawn up.

Electropoion Fluid.—Recipe for electropoion fluid: Mix well 100 parts of water, 12 of bichromate of potassium, and 25 of sulphuric acid. The last should be carefully added, as great heat is evolved in the operation.

TWO-FLUID BATTERIES.

CHAPTER IX.

The Daniell Battery.

Each cell or element consists of a glass vessel with an inner and an outer cell, divided by a porous partition to keep the separate liquids in the two cells from mixing, Fig. 4. A copper cylinder is placed outside and a rod of amalgamated zinc inside the porous cup. The liquid in the inner cell is dilute sulphuric acid; that in the outer cell a saturated solution of blue vitriol (sulphate of copper). Some crystals of the same substance are placed in a perforated pocket at the top of the cell in order that they may dissolve, and replace that which is used while the battery is in action. When

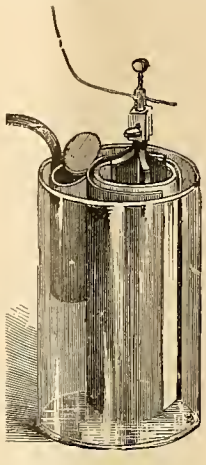


FIG. 4 —DANIELL BATTERY.

the circuit is closed the zinc dissolves in the dilute sulphuric acid, and liberates hydrogen gas. The gas, however, does not in this case appear in bubbles on the surface of the copper electrode, as, by a chemical process, the freed atoms of hydrogen traverse the pores of the porous cup, and are exchanged for copper atoms. So while the zinc dissolves the copper grows, the dilute sulphuric acid gradually changing into sulphate of zinc, and the sulphate of copper into sulphuric acid. There is, therefore, no polarization so long as the copper solution is saturated and the battery is very constant. It is mainly used as a standard cell for electrical measurements and in telegraphy.

The directions for gravity battery, given later on, will apply to the maintenance of the Daniell.

CHAPTER X.

The Grove Battery.

This battery, Fig. 5, consists of a glass or ebonite jar containing the amalgamated zinc cylinder and dilute sulphuric acid In the inner porous cup a piece of platinum foil dips into nitric acid of the greatest strength. There is no polarization, for the hydrogen liberated at the zinc plate, in passing through the nitric acid on its way to the platinum pole, de-

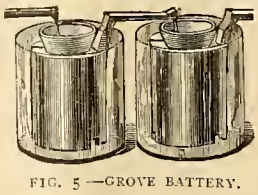


FIG. 5 —GROVE BATTERY.

composes the nitric acid, and is itself oxidized, producing water and the red fumes of nitric peroxide gas. This gas does not produce polarization, as it is readily soluble in nitric acid. The battery has both greater electromotive force and lower internal resistance than the Daniell, and will furnish continuously for three or four hours a strong current.

Directions for setting up: The glass jar is filled with dilute sulphuric acid, about one part of acid to twenty of water, and the porous cup, with fuming nitric acid, about 40°. The platinum plate being placed in the porous cup and the zinc in the glass jar, the battery is ready for use. The plates should be removed and cleaned, and the nitric acid emptied out when the battery is not in use. The binding screws should be examined, and the zincs amalgamated before again setting up the battery.

The fumes of this battery are poisonous, and should not be inhaled.

CHAPTER XI.

The Bunsen Battery.

This battery, Fig 6, is a modification of the Grove. The expensive platinum foil is replaced by a plate of hard gas carbon.

The battery is set up in the same manner as the Grove

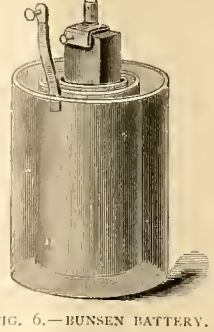


FIG. 6.—BUNSEN BATTERY.

Care must be taken to get a good clean contact between the carbon and the brass clamp.

CHAPTER XII.

The Carbon Battery.

The carbon battery, Fig. 7, is identical with the Bunsen.

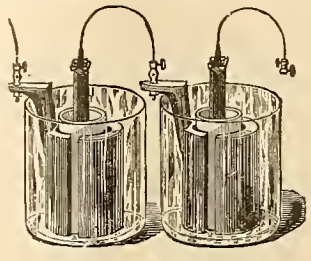


FIG. 7.—CARBON BATTERY.

Diluted sulphuric acid is used in the outer jar, and electropoion fluid, instead of nitric acid, in the porous cups.

CHAPTER XIII.

Nickel-Plating Battery.

This battery, Fig. 8, also is a modification of the Bunsen cell. It is of great power, and is used for nickel and electro plating, running electric motors, etc.

In setting up the battery amalgamate the zincs thoroughly, inside and out. Into each porous cup put two ounces of nitric acid, and half fill the cup with a mixture

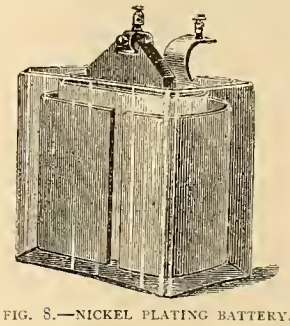


FIG. 8.—NICKEL PLATING BATTERY.

of equal parts, by measure, of water and sulphuric acid. Place the carbon in the porous cup, and add the mixture until it reaches the proper height, as mentioned below. Put the zinc in the outer or glass jar, and fill to the top of the zinc with a mixture of one part of sulphuric acid to twelve parts of water, previously mixed and allowed to cool. The fluids in the porous cup and outer jar should be of the same height. When the liquid in the jar becomes milky replace it with fresh solution. Add occasionally a little nitric acid to the liquid in the porous cells, and keep the zincs well amalgamated.

Instead of nitric acid electropoion fluid may be used in the porous cup.

CHAPTER XIV.

Fuller's Mercury Bichromate Battery.

A solid, well amalgamated block of zinc put in the porous cup forms one pole; a carbon plate in the outer jar the other pole. See Fig. 9.

This cell is set up as follows: Make a paste by mixing pulverized bichromate of potash with strong sulphuric acid

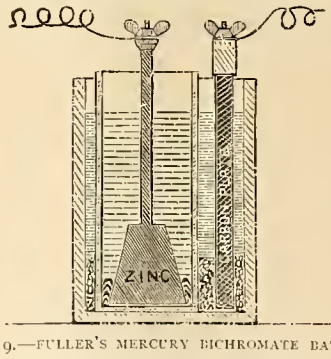


FIG 9.—FULLER'S MERCURY BICHROMATE BATTERY.

in about equal parts by weight. Put about ten ounces of this paste into the outside jar, pour over it two or three ounces of sulphuric acid, and fill with water. Into the porous cell pour a tablespoonful of mercury, put the zinc in place, and fill with water. The zinc should be lifted out occasionally, and the sulphate washed off. Keep a supply of mercury in the porous cell, so as to have the zinc always well amalgamated.

This cell is largely used in telegraphy, especially in England. It will stand longer continuous use than the Leclanche, but it is not so economical.

At Columbus, Ga., September 10th, the telephone wires and the electric light wires became entangled while a full current was on the electric light wires The telephone wires were damaged to a considerable extent, and night operaror W. H. Galloway had a narrow escape, as the current communicated with central office. Mr. Galloway had the head telephone on at the time, but prompt action on his part saved him from injury. The call wire, switch-board and head telephone were also damaged.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

PAGE

Electrical Housework Novelties, Illustrated 191
A New Meterage System, by W. Lowrie, Illustrated..... 191, 192, 193
Thomson-Houston Lynn Factory, Illustrated..... 193, 194
Bell Hangers' Hand-Book, by F. B. Badt, Illustrated, Part I:
Voltaic Electricity 194, 195
Single Fluid Batteries..... 195
Two Fluid Batteries 195
Editorial..... 196
Death of Oscar G. Clark by an Electric Shock..... 197, 198
Novel Installation Projected at Marquette, Mich 198
Practical Talks by Practical Men:
Electricity, by Dr. Schuyler S. Wheeler 198
Electricity as an Employment..... 198
The Aluminium Process..... 200

DEPARTMENTS.

Correspondence 198, 199, 200
The Electric Light 200, 201
The Electric Motor..... 201
The Telephone. 201
The Telegraph 201
Miscellaneous Notes 201, 202
Electrical Patents 202

Bell Hangers' Hand-Book.

The great favor with which Dynamo Tenders' Hand-Book, by F. B. Badt, was received by electrical and non-electrical readers, as evinced in the quick sale of the entire first edition of 2,500 copies, proved conclusively the soundness of the opinion of both author and publisher, the WESTERN ELECTRICIAN, that there was a field for it, and strengthened the belief held at that time and now, that a similar treatise in the same plain, easy, practical style, on subjects coming within the scope of the title, BELL HANGERS' HAND-BOOK, would be valuable to a large number of persons both professional electrical workers and laymen. The first installment of BELL HANGERS' HAND-BOOK, conceived as intimated, at the time its predecessor, DYNAMO TENDERS' HAND-BOOK was written, is presented in this issue and we confidently look to a reception for it as favorable as that extended the former. Installments will follow as far as possible in consecutive issues, and the whole will then be published in form similar to that of DYNAMO TENDERS' HAND-BROK, i. e. a pocket companion. Professor Badt's sound training as an electrical engineer, his wide range of knowledge, his familiarity with the best thought of America, England, Germany and France, through his acquaintance with the languages of those countries, have thoroughly fitted him for the preparation of a hand-book of the character outlined.

The tenor of the work is found in the chapters published this week. Taking up the general subject of voltaic or galvanic electricity, the author describes a simple primary cell, treats of the generation of current, local action and polarization; and then describes all the leading primary batteries, a portion of which are included in this week's installment. Other subjects that will be considered are: The connecting of batteries in series, multiple arc and multiple series, electro magnets, induction coils, electric bells, annunciators, burglar and fire alarms, electric gas lighting apparatus and electric heat regulators, and a host of accompaniments. The whole will cover a ground not covered by any book extant in the English language, and will afford a genuine treat to a wide range of readers.

THE great advance in the cost of copper during the year has become a matter for serious consideration to the manufacturers of brass, steam and water goods in which copper is used. Last week representatives of twenty-two firms, who produce 85 per cent. of the $30,000,000 worth of goods of this class marketed annually in the United States, met in Chicago to consider the situation. The unrepresented 15 per cent., however, had a deterrent effect upon increasing prices, and it was resolved to maintain the present discount sheet until the annual meeting, December 12th next, in New York.

T. L. CUNNINGHAM of Glasgow, Scotland, a member of the Stock Exchange of that city, was recently in Chicago. In speaking of the copper trust, he said to a reporter that he thought the French syndicate had got a grip on copper that would continue at least three years longer. It was selling at £86 sterling a ton when he left Scotland. Those who had sold in order to buy cheaper were still paying the advance price, and most of those who had sold for future delivery had bought back. The syndicate was remarkably well backed, and those who had got in on the ground floor at the start had made fortunes.

A METER for alternating currents is a live subject, and one that is receiving the closest attention at the hands of some of the most prominent electricians of America. Success has happily crowned the efforts of several, but by no means has the field in this direction been exhausted. The Lowrie system, described before a meeting of the British association in England, is accorded considerable space this week. As will be noted, the novelty of this system consists in introducing a constant electromotive force into the main or alternating current, to produce a subsidiary extra current, which, with a deposition cell in circuit, brings about a measure for current. The novelty of the system, at least, commends it to attention.

NO AMERICAN need be ashamed of the position occupied by the United States in the matter of applied science in comparison with other countries, writes a correspondent of *The Boston Herald*, referring to the meeting of the British association at Bath. He describes in this way the exhibition of slectric welding:

"A modest young American, Mr. Fish, stepped forward at a nod from the professor, put two pieces of bar iron, an inch square, into one of the Boston electric welding machines, turned on the electricity, and, in about the time a man of slow utterance could say Jack Robinson, held the two pieces made one at a white heat up to the view of the astonished audience. Then came a tremendous round of applause."

DR. SCHUYLER S. WHEELER and Francis B. Crocker last week opened the course of practical lectures before the Young Men's Christian association of New York. Their addresses are printed in another place in this issue. Dr. Wheeler gave a brief introductory address, and followed with a series of experiments. Mr. Crocker spoke on employment in the electrical field. It was a simple, practical address. He spoke of the nonsensical notions which exist concerning electrical matters, and especially of the senseless ideas of danger. He gave to the young men sound advice on the qualifications necessary for attaining success in electrical work. Both addresses were entertaining, and interested the young men in a marked degree.

ACCORDING to a table prepared by the *Progressive Age* there are 153 gas companies in the United States and Canada which operate electric light plants. The number of lamps maintained is about 13,000. The paper adds: "This is certainly a most gratifying as well as remarkable showing, and now that the ball has commenced to roll it will not be long ere double this result will be apparent. The *Progressive Age* congratulates the gas fraternity on the liberal policy which has made this attainment possible, and the different electric lighting systems which enjoy their confidence, that they have found this new and profitable field for the employment of their talents and business energy. Finally, we find ample reason to cause us to feel gratified in the knowledge that we assumed the brunt of the battle, smoothed the way and led the forces on both sides which are now enjoying the fruits of victory. It pays to be progressive in this age."

IN his address before the convention of the underwriters of the Northwest, Col. C. M. Ransom said: "The fire hazards attaching to all branches of business where electric wires are used, as well as all central stations, is probably the most difficult to understand; and judging from the frequency of electrical fires, electricians themselves are unable at all times to predetermine the point of danger until a fire occurs; that particular element or point of hazard can then be properly guarded against, and thus in time will that important industry become quite as safely insurable as any other."

The question of insurance of buildings lighted by electricity is one of great interest to electric light companies, as it has an important bearing on the extension of their business. The character of installations is now so much better than a few years ago, the quality of the work being more careful, that the risk is becoming safer every year.

A COMMITTEE of the Medico-Legal society of New York city has been engaged in investigating the best means of inflicting the death penalty by electricity. A report is being prepared which will contain, it is said, important recommendations. In this connection the following paragraph from the St. Louis *Globe-Democrat* is of interest:

"Dr. Richardson and Dr. Hammond are getting some notoriety by opposing capital punishment by electricity. They aver that there is danger that the criminal will not be killed by the shock, and may even recover after burial. These objections are sufficiently answered by an English scientist who has experimented on calves and fowls. The death was almost instantaneous, and unquestionable. He concludes that 'a flash rightly directed would kill a mammoth instantly if the tension of the induced current is high.' 'Death is instantaneous and painle s.' 'I never observed any effusion of blood or other symptoms of the shock.' The change is desirable, not at all on account of the criminal, but for the sake of the living actors. Hanging is a brutalizing affair. Capital punishment should be secret, with the fewest possible witnesses."

THE Chicago city council finds it extremely difficult to transact business in a legislative spirit. The aldermen grow angry, indulge in personalities and adjourn without accomplishing anything. The telephone ordinances came before the council last Monday evening as special orders. Alderman Ernst moved that the majority report of the committee on licenses be adopted. This measure provides that the rental for telephones shall be $95 the first year, and $85 for each succeeding year, or $75 per year on three years' contracts. Alderman Bartels moved the adoption of the minority report, which put no limits on prices but requires the company to pay into the city treasury 2½ per cent. of its gross receipts. The minority report was substituted for the majority report by a vote of 24 to 17, after which the aldermen adjourned, without taking final action.

The discussion of the ordinances was of the usual kind. The company was berated in the ordinary terms. One of the aldermen very sensibly referred to the hardships which the citizens would suffer if rash action was taken. It had been stated that the corporation was conducting its business without a charter. A letter from the company was introduced, stating while the corporation counsel claimed the telephone company was without a charter, the company had never admitted it, and claimed that the city had, by various acts, acknowledged its rights.

Death of Oscar G. Clark by an Electric Shock.

An unfortunate accident which caused the death by an electric shock of one of the employes occurred, October 3, in the repair room of Thomson-Houston company, 148 Michigan avenue, Chicago. O. G. Clark was at work testing arc lamps, which were running from a fifty light dynamo. The machine was loaded with 44 or 46 lamps, the number varying slightly. He received the shock which caused his death, in this way: He held a part of the lamp which he was testing, in his left hand. He reached around the lamp with the intention of throwing the switch off by means of a stick which he held in his right hand. As he did so he raised the lamp from the hanging wire and short circuited the current through himself. The current passed from his left hand to the elbow of his right arm. He groaned and fell backward upon the floor. He breathed heavily for a few seconds and then respiration ceased. The heart continued to beat for about ten minutes. Two physicians were immediately summoned, and for three hours endeavored to resuscitate the unfortunate man but without success.

The circuit was a short one which had been put up for testing purposes only. Only the lights which were being tested were on the circuit. A short time before the accident occurred George Cutter, the electrical engineer in charge of the department, had tested the circuit for escape to ground and had found it in splendid condition. The circuit was subsequently tested by employes of the company not connected with Mr. Cutter's department, and by C. C. Haskins, city inspector of electric lights, and the resistance was found to be over 1,100,000 ohms. When the lamps were hung the precaution was taken to cross the connections in such a manner that a person touching two lamps could not receive more than two lamps tension.

Clark, at the time he received the shock, violated the positive instruction given him less than an hour before by Mr. Cutter, who had cautioned him in the presence of another employe, not to use both hands in testing the lamps. He was a bright young man, about 30 years of age. He came to Chicago from Bloomington, where he was a machinist. He had left his position there to learn the principles of electric lighting. He was quite familiar with his work, as he had been in the employ of the company in Mr. Cutter's department since May. He was ambitious, and gave promise of becoming an expert. His one failing was a tendency to be too forward in making experiments. He leaves a wife and child.

In its account of the accident, the *Inter-Ocean* speaking of the lamp circuit, says: "None of the wires on these instruments are insulated, the room being a sort of repair shop." The statement is entirely erroneous. The wires are all insulated thoroughly to the very hook on which the lamps are hung. A representative of the WESTERN ELECTRICIAN who examined the circuits found them in excellent condition. The work does not in the least present the appearance noticeable in many testing rooms. Mr. Cutter has always made it a point to employ every safeguard.

The coroner's inquest was held October 5th. A considerable number of electricians and persons interested in electric lighting was present. Prof. J. P. Barrett, city electrician, aided the coroner in his inquiries, and Attorney Judah looked after the interests of the Thomson-Houston company. A jury of six was impaneled. The first witness was Omer I. Clark of Pleasant Lake, Steuben county, Ind., the father of the decedent. He testified briefly to his son's character. He said Clark had an experimental turn of mind, and when 14 years of age had made a telegraph instrument which worked perfectly. Witness knew nothing of his son's experience as an electrician.

L. E. Spafford, a machinist employed in the repair shop of the Thomson-Houston company, was next called. The witness testified in substance: "I knew the deceased a little over two weeks. I worked in the same shop with him. At the time of the accident, he was testing lamps and adjusting them. One did not work and he called me to him to explain why, so I would not make any mistake in the next lamp I repaired. After he had told me this, I stepped away from him two or three feet, when he started to throw the switch onto the circuit again. He put one hand on the lamp at a place where all employes are instructed not to touch it. In fact, they are told not to touch it at all with their left hand. Clark had a stick in his right hand. It was not quite long enough to reach the switch on the ceiling and he had to lift himself a little to reach it. In doing so he brushed his arm against the lamp. As he touched the lamp he lifted it a little so it was thrown off the hook on the wire. This made a short circuit and he got the full force of the forty or fifty lamps. Just as he touched the lamp he said 'oh!' and staggered back. He then fell back upon the floor. I sprang toward him and tried to lift him up but could not do so. Several of the men came and some one called out to stop the dynamo. The men began to rub his limbs, and to put cold water on his head. Mr. Cutter called to one of the men to go for a doctor. He came in five or ten minutes. Clark was picked up and carried into Mr. Cutter's room. The doctors were working over him when I left.

"The employes are forbidden to put their hands on the lamps when they throw the switch. Mr. Cutter has told the men not to do that or to put their hands on any iron post or wire I did not receive these orders myself because I am not obliged to go near the lamps."

A JUROR: "If the stick had been longer would he have touched the lamp?"

WITNESS: "No, sir. There is no special stick used to throw the switch. Any stick is picked up. With the stick which he had, he had to jump in order to reach the switch. I think testing lamps is a dangerous kind of work. Other work, such as I do in the repair shop, is no more dangerous than work in any machine shop."

A. A. Lantau, electrician in the employ of the Thomson-Houston company, testified that he had worked in the shop with deceased for about four months and a half. He continued: "I was standing five or six feet from Clark at the time of the accident. All of a sudden I heard him cry out. Whether I heard the spark when he made the connection with the lamp or not I am not sure. If I did not, I imagined it. I saw him stagger, but before I could get to him he had fallen on the floor. I unbuttoned his shirt and his collar, and took his necktie off. Several of the employes hurried to the spot and commenced to rub him and to put water on his forehead. This continued for about ten minutes. During this time he drew two long breaths, and that was the last sign of life I saw.

"The lamps were so hung that a person could not get a severe shock by touching two lamps, unless the position of the lamps was disturbed. The circuit had been tested for grounds and we were sure no current was escaping to ground. Everything was so arranged that an accident could occur only from ignorance or carelessness. I overheard Mr. Cutter speaking to the deceased of the danger of testing lamps a short time before the accident. We had frequently been told by Mr. Cutter of the danger we were in when we handled apparatus carelessly.

"There are two wires hanging down from each switch; at the very ends they are bare to form contacts. The switch is on the ceiling, and is too high to be touched without a stick. The deceased had the short stick in his hand when he fell. The stick was so short that he could not have reached the switch without jumping slightly. The accident probably occurred in this way: He was holding close to the binding post with his left hand as he made a jump to throw the switch, his right arm came in contact with the other post."

A JUROR: Why was the switch board placed up so high?"

WITNESS: "So as to be out of the way, and be safer. He had no business to keep his hand on the lamp when he threw the switch."

PROF. BARRETT: "Was there any dampness noticeable in the basement?"

WITNESS: "No, sir."

The witness, at the request of Prof. Barrett, described the mode of constructing an arc lamp and indicated how a person could receive a shock in handling it.

Dr. Charles B. Reed was the next witness. He testified: "About 3:15 P. M. I was called to attend a man at the shop of the Thomson-Houston company. I found the man in Mr. Cutter's office surrounded by several persons, among whom was Dr. Depew. He was giving the man brandy. I found no pulse or respiration. We gave hypodermic injections of whiskey, brandy, ammonia, and nitro-glycerine. We kept up artificial respiration and made hot applications. None of these means seemed to have any effect. We continued for about two hours and a half and at the end of this time finding no evidence of life, we gave up the case as hopeless. There was a brown spot on the right arm just above the elbow, and a few little spots as a sort of continuation of the first spot which was about as large as a grain of corn. In my opinion death was caused by an electric shock."

PROF. J. P. BARRETT: "How much electricity can a person take and survive?"

WITNESS: "It would be hard to say. It depends upon the system."

PROF. BARRETT: "Do you refer to alternating and continuous systems? I thought it was agreed we would not bring that discussion into this matter."

WITNESS: "Oh, no. I had reference to the systems of persons."

George Cutter, electrical engineer of the Thomson-Houston company, was the last witness. He testified:

"The deceased came to work for me in May last, and continued until his death. He was testing lamps at the time of the accident. He had been instructed not to adjust any of the lamps but to watch them working and to report to me, so I could explain what was necessary to make them work properly. In the forenoon we had put up the testing circuit at which he was at work. After lunch I explained to him the danger of handling two parts of a lamp at the same time. I told him the lamps were there for repair, and were very likely to be imperfect. I told him he ran the risk of opening the circuit and killing himself instantly. I told him distinctly that he would not know what struck him, and he must not run the risk. At the time of the accident I was at work on a dynamo in the middle of the room. I found Clark lying on his back gasping. We began to work on the body to start the circulation and respiration, but our efforts failed. I sent for doctors and left Clark in their charge.

"The lamps were hung from switch boards fastened to the ceiling. The wires from the lamps to the switchboards were underwriters'. The insulation was removed as little as possible in making the connection with the lamp. The two rows of six switch boards were each provided with a switch called an absolute cut-out, so made that when thrown off to extinguish a lamp the testing current was closed; but my lamp hanging wires were in no way in contact with the dynamo circuit. I had also taken the precaution to cross my connections so that if a person touched two lamps he could not receive more than two lamp tension."

PROF. BARRETT: "Would that cause serious hurt?"

WITNESS: "No, sir. I practically reduced the danger of a fatal shock to a break in the current or an escape to ground."

MR. JUDAH: "Was he experienced in the business?"

WITNESS: "Not to my knowledge, previous to his service in my shop. He was a pretty good machinist and ambitious to learn."

MR. JUDAH: "Was there anything else you could have done to make the work safer?"

WITNESS: "Nothing that I can think of now."

PROF. BARRETT: "Why do you think there was no ground current?"

WITNESS: "I think the evidence that he stood there and received no shock until he tried to throw the switch, is evidence that there was no ground. We tested the circuit a short time previous to the accident. It was a short circuit, purely for testing purposes."

PROF. BARRETT: "What apparatus do you have in the shop?"

WITNESS: "We have from time to time all the apparatus made by the Thomson-Houston company. It is the repair shop for the western department. We light the building with a 400 light incandescent dynamo; 240 amperes and 110 volts. We used 9 arc lights when we were settling in the building.'

PROF. BARRETT: "You understand the laws relating to electric lighting?"

WITNESS: "Yes, sir. I think I have complied with all the rules of the city inspector."

PROF. BARRETT: "Have you a certificate from him?"

WITNESS: "No, sir. I consider that the plant is still in a transitional state. I have consulted with the inspector from time to time. I can't say when I asked for inspection. He has examined the plant from time to time. We sent for him after the accident."

PROF. BARRETT: "Why did you do that?"

WITNESS: "We wished to have him examine the circuits and the conditions. He said it complied with the law."

PROF. BARRETT: "Are you aware that it is a violation of the law to run a plant without a certificate?"

WITNESS: "I have not considered the plant complete. The inspector told me distinctly I did not need a certificate in my testing room. He said the law of inspection was not enforced in the shops of electric light companies."

Prof. Barrett handed the coroner a copy of the city electric light regulations, and asked that they be given to the jury. Mr. Judah said he desired to object. The city inspector had pronounced the plant all right. Giving the jury the rules was a reflection on the city inspector, as he had said the plant complied with the law. Prof. Barrett said he cared not upon whom a reflection was cast; he

wanted the rules to go to the jury, so they could see if any ordinance had been violated.

The coroner gave the ordinances to the jury without comment.

After a conference of half an hour the jury found this verdict:

"We, the jury, find that Oscar G. Clark came to his death from an electric shock while opening a switch at the Thomson-Houston Electric company's works; also that we believe the company is greatly to blame in not complying with the law."

A Novel Installation Projected at Marquette, Mich.

At the meeting of the city council of Marquette, Mich., October 2d, a resolution was passed employing Fred. H. Whipple to act as adviser to the city in the investigation of the question of electric lighting, and to make complete plans for remodeling the waterworks. Mr. Whipple has carefully studied the natural facilities at Marquette, and has in mind a most unique installation. Within two and a half or three miles of the city there is a great water power of the Dead River, which is practically going to waste. At one place within a short distance the difference between levels is 140 feet, and the water can be used fourteen times. The idea is for the city to purchase the water power for its own use, and establish an electric plant to furnish lights for the streets, commercial lights, power to run the city waterworks, and power to private consumers. Mr. Whipple estimates 100 arc lights for street lighting, 1,000 incandescent lights for commercial use; 350 horse power to run the waterworks and 1,000 horse power for private use. No franchise for electric lighting has been given by Marquette, consequently the city would have no competition in that direction. The availability of the water power would make the work of installation very easy. The city, by renting power and lights, can light its streets and furnish power for its waterworks at a nominal cost. The members of the city council appreciate the advantages within their reach, now that they have been laid before them, and there is a prospect of the city carrying out Mr. Whipple's plans.

Practical Talks by Practical Men.

The above is the title of a course of instructive lectures just begun in New York city under the auspices of the Young Men's Christian association. "Electricity; Its Modern Applications," was honored with the first place on the programme, and Dr. Schuyler S Wheeler, assisted by Francis B. Crocker, was selected to present the subject in a popular manner before an audience of young men. Considerable surprise was manifested at the size of the audience which greeted these gentlemen at Association hall on the evening of October 5th. At 8 o'clock, the hour announced, the 1,250 seats were filled, a large number were standing, and the police, under instructions of the management, turned away about 200 more. On the platform was arranged the working apparatus in ordinary use, consisting of arc and incandescent lamps, and a small motor. As it was to be a practical demonstration, an actual working arc light, and also an alternating current, were brought into the room from the system of the East River Electric Light company, the Y M. C. A. building not being as yet furnished with electric lights in any form. A large coil of small underwriters' wire and a movable core, consisting of a piece of iron gas pipe, was arranged to illustrate the attractive force of the electric current, which it did most effectually, showing very clearly the power of the invisible force so mysterious in its operation to the ordinary observer.

Dr. Wheeler, upon being introduced, prefaced his experiments with the following preliminary remarks:

Dr. Wheeler's Remarks.

I have collected some apparatus to show the most important actions of the force which we call electricity, and I propose to talk with the object of showing you that it is after all, quite simple and easily understood. I think this is decidedly better than the usual plan of showing or describing a few surprising results, and then leaving the audience to think that the whole subject is very mysterious and incomprehensible. The idea many persons have is that electricity is uncertain, vague, difficult to control, and sometimes almost supernatural. This is entirely wrong. Electricity is thoroughly practical; it acts in regular and well defined ways, and invariably follows its own laws or habits with such mathematical perfection that the results which a given electrical machine will produce can always be correctly figured out beforehand.

The first question usually asked, "What is Electricity?" is really not of much importance. But this much may be said: It is not a separate substance by itself like water or steam, but is a state of matter; that is, it is some kind of internal motion or twisting of the infinitely fine particles or atoms which compose all substances, and thus, although we commonly speak of sending a current of electricity through a wire, we really mean that we will get the stuff that the wire is made of into a state of invisible motion, or thrilling with vibrations within itself. In this respect electricity closely resembles heat, which is known to be also a vibration of atoms, but in which the motions go on in a much more disorderly way.

Electricity has three remarkable properties: Attraction through space; convertibility into heat, and the power of tearing chemicals apart or decomposing them. Upon these three properties depend all of its uses, no matter how complicated; and it is in devising ways to make use of these features to accomplish what could not be done before, or what was not as well done before, that the work of an electrical engineer comes in.

Perhaps the most difficult part of the subject to understand is the power of attraction, because we are not used to seeing small bodies attract each other as they do when electrified. But we accept without question the attraction of the earth for small articles, by which they are caused to have weight and to fall, and we do not consider mechanics a difficult or mysterious science. Machines are sometimes run by weights. The proper way to enter the subject is to take this fundamental fact for granted, as we do with gravity, ascertain the laws which govern its action, what is in plain terms the way it works, and then to plan machines accordingly, just as we go to work with weights, knowing that gravity will exert a certain force.

Dr. Wheeler's first demonstration was the attraction of the current, the iron core being suspended so that it swung freely into the interior of the coil when the arc lighting current was passed through the latter. The coil was then placed in a horizontal position, and the core caused to jump from the table below. The weight of the core, as shown by its fall when the current was broken, was strikingly apparent to the entire audience. Dr. Wheeler then explained very clearly that this principle of attraction was the basis of the most familiar commercial applications of electricity, the telegraph and the telephone. The principle of the motor, the arc and the incandescent light, were then shown, the carbon points and the carbon loop being shown by their own light thrown on a screen through a lens. The heating effect of the current was effectively shown by the melting of an iron wire stretched between two supports. All these demonstrations were carefully followed by the large audience, who greeted them with frequent applause. Upon their completion Mr. Crocker was introduced, who called the attention of the young men to the field offered by electricity as an employment, in the following words:

Electricity as an Employment.

BY FRANCIS B CROCKER.

Mr. Wheeler has shown, by his experiments and explanations, that electricity is perfectly practical and not entirely mysterious; that it produces its various mechanical, thermal and chemical effects, according to well known and definite laws, and that these effects can be turned to useful account in an almost infinite number of ways. In fact, I think it might be fairly said that electricity does its work more reliably and more effectually than any other known natural agency.

These facts apply directly to electricity as an employment. It is a perfectly practical and legitimate business or profession, and a man is not necessarily either a wizard, a quack, or a crank who is engaged in it. There was a time, and it was only a few years ago, when electricity was used to deceive the public more than to benefit it. In this way the title of electrician became somewhat tarnished, and to-day there is a strong tendency, largely due to this fact, to adopt the new and untarnished title of electrical engineer, and leave the old name to the quack doctors and showmen. Fortunately, as electricity is better understood, its quackery and imposture disappear compared with its real growth, and I think every honest electrical worker should feel that it is decidedly his interest as well as his duty to weed out the false at the same time that he cultivates the genuine in this field.

The much talked-of danger of electricity is to be considered before we go into it as a business. This fear is very much exaggerated, as there is actually no more danger than in the case of any other powers, such as gas, steam and water. In general and widespread destruction it is very much less dangerous. There is rarely more than a single victim at any one time. Contrast this with a steam boiler explosion. The possibility of instant death, of course, exists all the time, but it requires a peculiar combination of circumstances to cause it. In the first place, two separate contacts must be made before there is any danger whatsoever, and these contacts must be on two sides of a vital organ. For example, a man making both contacts with the same hand would only have his hand burned, and there would be no serious danger; but taking hold of two wires, one in each hand, is the most likely danger. It is of course possible to make one contact with the hands and one with the feet, but even then it would be dangerous only when a man actually touches the ground, or some conductor leading to the ground.

We ourselves have been handling all the evening arc circuits about as dangerous as any ever met with. If reasonable care is taken, there is no danger. A man entering this profession need have no more fear of danger than when he crosses Broadway or passes in front of a "bobtail" horse car. In short, the risk is no greater than the ordinary and unavoidable risks of daily life.

Having disposed of the danger, the next question which arises is what kind of a man is required in this business. The answer is, that it does not require a peculiar individual. A man need not let his hair grow long to make a good electrician; any person of ordinary intelligence, without regard to race, color, or previous condition of servitude, is eligible.

As to whether it is best to go into the business or scientific branch of the industry, that depends entirely upon the man's taste and ability, and he can generally decide that point readily for himself. There is room at the desk as well as in the laboratory, drawing table and work bench, and no one of these places is more important than the other, and the possibilities of success and a good salary are about equal in each case.

The preparation for entering this business is education and experience, and even these, though of course very desirable, are not absolutely necessary. It would generally be sufficient for a man going into the strictly business part of electricity to have had experience in some other branch of trade. In fact, a boy might go directly from an ordinary school into electrical business and have a very good chance of success, but if a young man has the time and money to spare, he will do very well to take a course in electrical engineering at some college, like Cornell or Stevens institute, where particular attention is given to this subject, or at one of the scientific schools of Harvard, Yale or Columbia. It is not necessary to go abroad to study, as more is actually done in one state on this side of the Atlantic than in the whole of Europe, including England. This education is more important to one going into the scientific part than to the prospective business man, but it would be time well spent in either case. Self education is perfectly possible, and frequently produces the highest results. Edison himself is a distinguished example of this. I think persons generally stand too much in awe of the difficulty of understanding or even partially understanding this subject by their own exertions A general idea of it is by no means difficult to obtain. Three or four days spent in studying an electrical book, or, still better, an electrical factory or station will give one quite an inkling, and this improves and grows rapidly without much effort, if one is brought into daily contact with electrical things. I do not mean contact in the electrical sense, as that would be apt to destroy any one's knowledge of everything very promptly.

The next point to decide is what branch or application of electricity to select. This also depends somewhat upon the individual, but in most cases a young man would probably take the first good chance offered. But I think as a man can usually steer his own course more or less, it is well to know which way it is wise for him to try to go. It is considerably easier to go with the current than against it. In other words, there are some applications of electricity that are advantageous and easy of themselves, and some that are not, and if a man takes up one of the former class he is likely to be comparatively successful, whereas, if he takes up one of the latter classes, he will have up-hill work, entirely irrespective of his own industry and intelligence. To take extreme examples, electricity will run these arc and incandescent lamps very satisfactorily, but so far it has not been found practicable or anywhere near practicable to run an ocean steamer by it. Any one taking up arc or incandescent electric lighting as a business, will probably do well, but if any one was visionary enough to attempt making a business of building or operating electric ocean steamers, he would be very apt to die in the poorhouse or lunatic asylum. Of course it is possible that all this may be changed at any time by new discoveries, but all one can do is to judge by what is already known, and in the case of a beginner, it certainly is not wise to go beyond this. To carry this idea still further, one can judge of the likely directions of electrical progress, even before the advance occurs, and it is in one of these favorable directions that a man should try to go. The generation and distribution of electricity for light, power and other useful purposes is a very good branch of the business to choose, because it is the fountain head, and all electrical progress in any direction will probably benefit it.

The propulsion of street cars by electricity is just now of particular importance, and this business is destined to be of great magnitude and one demanding the employment of hundreds of intelligent young men to run the central generating stations. The telegraph, which is the oldest and best established electrical business, is still a pretty good field. The telephone, which is financially the most successful of all, is a better field. Lighting is growing very rapidly, and will probably spread still faster in the future. Motor manufacturing and renting is one of the most promising branches. Primary and storage batteries are not so satisfactory, I am sorry to say.

At the close of the lectures, Dr. Wheeler was surrounded by a group of about fifty young men who were anxious for more light, and apparently eager to talk upon the subject of the evening With an incandescent lamp aglow in his hand, the doctor entertained his listeners for a half hour with electric aftermath.

Among the professional electrical people present were Judge W. H. Kelly, T. C. Martin, Charles Cuttress and R. W. Pope, who came early. Others who expected to be present were turned away on account of the crowd.

CORRESPONDENCE

Kansas City, Mo.

Kansas City, Mo., Oct. 6.—Day by day the new building of the Edison Electric Light company can be seen approaching completion. The massive stones of the foundation are all in place, and the big hollow iron pillars that will support the superstructure are being placed in position. Contracts have been let for all parts of the building and for the entire plant. The plant will possess at first a capacity of 6,000 lights, but will be arranged so that its capacity can be increased, whenever considered desirable, until 30,000 lights can be furnished the company's patrons from this central station. The Edison Machine works will furnish the dynamos and the Edison Lamp company will furnish the lamps and potential indicator. The electrical apparatus and meters will be supplied by Bergman & Co. The New York Safety Steam Power company will supply the engines. The boilers will be of the make of Babcock & Wilcox. The Pond Engineering company of Kansas City and St. Louis will have charge of the construction of the steam plant. The very latest date set by E. R. Weeks,

manager of this company, as well as of the Kansas City company, for the completion of the building is November 15th, and the latest date he has set for turning on the incandescent lights from this plant is December 1st.

While Mr. Weeks is deeply interested in this plant, and is proud of what it will finally accomplish, he is especially interested in, and considers his particular achievement, in the electrical line, the independent electric light plant that illumines his home. In a little addition to his residence, six feet wide and eight feet long, he has a dynamo, motor, regulator, picture of Thomson and picture of Edison. The pictures he considers a part of the plant; he believes they act as "mascots." The dynamo is one of Professor Thomson's latest designs, and has a maximum capacity of twenty-five 16 candle power incandescent lights. The motor is a Baxter of 2 horse power, constant current. The Baxter regulator is declared by Mr. Weeks to be one of the finest pieces of electrical machinery that he has ever seen or had any experience with. It gives a perfectly steady current, and more than that couldn't be said of anything. And he ought to know, for although this plant is a very small one, yet it obtains its power from an arc electric light circuit ten miles long. This plant is believed to be the first application of a constant current motor to drive a constant potential dynamo for incandescent lighting. If there are or have been any others, let them speak now, or forever after hold their peace. Mr. Weeks' residence is wired for thirty lamps, but, unless Mr. Weeks' candidate for the presidency should be elected, he hardly thinks he will ever have use for more than twenty lights at the same time. The plant represents a total outlay of about $500, and its operation, if the Kansas City Electric Light company, of which Mr. Weeks is general manager, should be inclined to bear down upon him, would cost about $10 a month. Gas would cost him $4 a month. If Mr. Weeks had to pay the difference he said he would gladly do it, on account of the better light, better service, and increased convenience. He estimates that one minute's attention a day is all that will be needed by his plant on an average. The current is cut off in the bathroom on the second floor, and if there is any necessity for turning on the light during the night all he has to do is to step into the bathroom and turn the switch. No hunting of matches, no breaking of them while endeavoring to strike a light, no mistaking of toothpicks for them, none of the many other botherations that accumulate on one who has arisen in the dark in the middle of the night, and is in a hurry.

H. W. Smith of St. Louis asks that a correction be made regarding a statement recently published in the WESTERN ELECTRICIAN in reference to the electric cable signal. It was stated that it was the invention of Mr. Smith and Mr. Hewes, of this city. Mr. Smith emphatically desires it to be understood that he is the sole inventor. It was also stated that the signal had been adopted by the Metropolitan Cable Railway company at the request of Superintendent Lawless. Mr. Lawless has not been connected with the Metropolitan company since Mr. Smith arrived here with his signal. He has explained its principles to the company and has two signals in operation showing how it works, and R. J. McCarty, the Metropolitan's general manager, has heartily approved of it, but the company has not yet decided to adopt it. Your correspondent also stated that, by means of the light connected with the signal and colored glass, the color of the approaching car would be indicated, as well as an alarm given. The signal of the kind intended for the crossing of one cable line by another, will have two colored glasses facing each way, red and blue. They are not intended to indicate the color of the car approaching, but as automatic indicators to the gripman whether he has right of way or not. Thus, suppose there is a signal at the crossing of cable lines A and B, and cars are approaching the crossing at the same time. If the gripman on A beholds the red light flashing upon his pathway he knows that the car on B is a little in advance of him and has the right of way. If the blue light shows first then he knows that he is ahead of the car on B and has the right of way himself. The cars throw on the signal lights and alarm, each at the same distance from the crossing. If a car is only a few inches in advance of the car on the crossing line, this signal gives it the right of way to which it is entitled, but in the case of a flagman he would have to decide the matter arbitrarily.

Chief Hale of the fire department, never tires of singing the praises of the telephone as a fire alarm. "After an inspection of most of the fire alarms of the country," said he, in an interview last week, "I do not hesitate to affirm that Kansas City is one of the most fortunate in this respect to be found in the world. What is more, the system doesn't cost the city a cent. To supply its place with anything else as efficient, would cost the city $100,000. We owe it all to the telephone company. Each engine house is supplied with a telephone which is connected with every one of the 2,500 instruments in the city. With a vigilance that never sleeps, 'No. 600' in the central office keeps special guard upon intelligence of fire. It takes precedence over all other kind of news. The instant notice of fire is communicated from any quarter of the city to the central office the operator receiving the message touches a key that throws the person giving the alarm into communication with 'No. 600.' He inquires, 'Where is the fire!' The answer is given, and almost before the sentence is complete the electrical alarm is sounded at the same moment in the different fire department stations, the horses have leaped into their places, and the hose carts are flying toward the point of danger. The only weakness in the system is that the large number of new houses being built in the outskirts of the city are without telephones. This is partly remedied by the fact that a person even at a distance can often tell the location of a fire and prevent the department from losing valuable time in making a run to the wrong point. The telephone is the best alarm invented. No mechanical arrangement can equal the human voice transmitted by electricity."

A meeting of the aldermanic committee appointed to investigate the question of telephone rates and report upon the amount of reduction to be insisted upon in the rates of the local company, met last week, but no report has yet been submitted. The committee has determined to await the decision of the state Supreme court in the St. Louis case, before taking further action in the matter. Besides, there has been a decided cooling of ardor on the part of all who at first were inclined to demand a reduction in the local rates. The agitation has caused bringing into public notice the many free favors the telephone company confers on the city, and has developed the fact that the rates are as reasonable as those of any telephone company, more reasonable than many, and arranged on a much better plan than the majority. Most of the patrons would really be willing to pay more than they do now rather than have the telephone charges made in accordance with the Indiana system.

The Inter-State company has moved into its new offices in the magnificent Keith & Perry building, and the company's central station plant in the basement of the building is rapidly approaching that point at which it can be said to be ready for operation.

General Manager M. E. Bates of the Western Electrical Construction company, reports that work on the Pine Bluff, Ark., electric light plant is well under way. Mr. Bates' duties in connection with this plant have caused him to spend several Sundays in Arkansas, and he vows that he will turn around and leave the moment he gets there the next time, if he discovers that by remaining any time at all he will be compelled to remain over Sunday. He says Sunday is surrendered to the colored population, and that a Caucasian stands no show on that day at all.

E. J. Lawless, the former superintendent of the Metropolitan Street Railway company, has gone East to visit all the cities in which electrical street railways are in operation. He intends to make a thorough investigation of them, going slowly and carefully into each detail. If he becomes satisfied that they are a success, an electric street railway will be established here.

C. H. Cone, representing the Electrical Supply company of Chicago, has been slightly under the weather, but is gaining strength rapidly now. He reports business brisk and the outlook for all kinds of electrical business splendid.

The Kansas City agency of the Thomson-Houston company has its plant at the exposition building in full operation, and the brilliancy and steadiness of the light furnished have received the highest compliments of the management of the exposition.

The Southwestern Electrical Supply company reports business picking up wonderfully, and that the prospects are for a greater trade in all kinds of electrical goods in the west than ever before.

Ben Friedburg, who obtained a franchise after many difficulties, and after passing through strange vicissitudes, including a fight, has organized an electric light company to be known as the Kansas City Electric company, which has been chartered by the state to furnish electricity for light, heat and motive power. The capital stock is $100,000. The directors are J. D. Wilson, Mark Harris, C. F. Hutchings, Benjamin Schneirle and Ben Friedburg. Nearly all the contracts have been let, and work has begun on the building for the central station. A.

New York Notes.

NEW YORK, October 6.—Trouble seems to be brewing again between the telegraph operators and the management of the elevated railroad, which has been brought on by the proposed re-establishment of the telegraph school at the Chatham Square station. This appears to be a pet scheme with some official who desires to give the gatemen an opportunity to better their condition, which is possible by their learning telegraphy. The operators claim that while they are paid from $70 to $75 per month, the new men will be quite willing to perform the same duties at about $20 less for the same time.

The fifty-seventh fair of the American institute opened October 3d, at its building on Third avenue above 63d street. It will be remembered that a considerable amount of space was devoted last year to an electrical exhibition. The managers were not altogether satisfied with the attendance, so that this feature will not be introduced this year, but a still greater attraction will be offered in the reduction of the admission fee from 50 to 25 cents. The interest in these exhibitions has been waning for several years past, and the electrical exhibition was organized last year in the hope that there would be a revival, but the managers seem to think the public did not appreciate the innovation. Mayor Hewitt's opening address was exceedingly appropriate, and was in a similar vein to that which proved so great a hit at the electric light convention.

These are exceedingly prosperous days for the Western Union Telegraph company, which now has the field practically to itself, and in addition to the unusually active business season there is the political canvass, which is exceedingly productive of dispatches. An old telegrapher, who now frequents Wall street, says there is nothing to prevent the stock reaching par before Christmas.

C. O. Mailloux, who has been the electrical engineer of the Julien Electric company since it started business in this city, has resigned that position. He has been very active in the important work of designing and supervising the construction of mechanism for the new electric cars on the Fourth avenue railroad. One of these new cars had a mishap a few days ago near the postoffice, where one of its trucks started up one track while its mate started up the other. It was a trivial affair, but it received due attention at the hands of the press.

There was to have been an examination at the Jefferson market police court October 2, in the complaint made by President Hess of the Board of Electrical Control, against Eugene T. Lynch as president of the United States Illuminating company, made last July, charging the company with misdemeanor in maintaining a public nuisance by keeping its wires above ground. When the case was called there was no appearance on the part of the prosecution. A letter was read from Mr. Chittenden, counsel for the defendant, stating that Assistant District Attorney Foster, who had charge of the complaint, had informed him that the complaint would be dropped, and no further action taken. Justice Duffy adjourned the examination for one month.

There was quite a serious horse car accident at Springfield, Mass., which may be considered an equivalent to those at Pittsburg on the electric road. The brakes did not hold the car while coming down a hill, the horses ran away, the car was overturned, and struck a tree. The car was wrecked, and the passengers injured by sprains and bruises.

Among the irregular loans discovered by the investigation of the affairs of the National Union bank at Fall River, Mass., was one to the Beattie Zinc company, manufacturers of battery zincs, for $23,000. This company has recently been engaged in increasing its plant to accommodate the growth of its business. It is presumed that the securities were not up to the standard ordinarily exacted for loans of that character.

Willis J. Cook, familiarly known all over the United States as "Bif" Cook, has been seriously ill for five weeks at the Roosevelt hospital in this city. He is now in a fair way of recovery, and it is thought will soon be well enough to be removed to the home of his family in Ohio. "Bif" is one of the old-time experts at the key, and has worked in nearly every large office in the country. P.

St. Louis, Mo.

ST. LOUIS, Oct. 6.—The recently incorporated Metropolitan Electric company, having a capital stock of $100,000, will use the Westinghouse incandescent lights. Dwight Tredway owns 996 shares of the stock, and Manning Tredway, H. B. Pike, Jos. A. Parker and A. De Figueiredo one share each. Dwight Tredway is the president of the new corporation and H. B. Pike secretary and general manager. "We have purchased the Excelsior electric light plant," said President Tredway, while speaking of the new enterprise, "and the electric plant at the Cable and Western power house. At the latter place there is a machine that is running 1,400 incandescent and 250 arc lights, and a machine of similar power will be placed in the Excelsior plant. We will furnish incandescent lamps at from 1c. to 1¼c. per hour for the time actually in use. Beers' hotel now burns 500 incandescent lights, and they are being rapidly introduced into a large number of residences in the west end. After our plants are fitted up in first-class running order, we shall furnish a large number of small motors,

from 1 horse to 30 horse power, for running light machinery of various kinds."

R. M. Stailey, 24 years of age, working in the Iron Mountain depot office at Maine and Gratiot streets, was standing at the telephone during a thunder storm a few days ago, when a flash was seen and Stailey's arm dropped to his side. His fellow-clerks rushed to help him and found he was paralyzed on his left side and could not move. He was placed on a bench, and rubbed vigorously. In about one hour he had sufficiently recovered to walk and was sent to his home. Another clerk, Daniel McCarthy, was standing near Stailey and also received a slight shock. E.

Texan Topics

El Paso, Tex., Oct 5.—The gas light and electric light question in El Paso has become somewhat mixed and interesting. There is established and in successful operation a company for the manufacture of gas, and another for electric light. The gas company consists of El Paso business men, and the electric light company of St Louis capitalists. There has sprung up between them an active and bitter competition, and each announces its intention to engage in the business pursued by the other. Last week the gas company obtained a charter and franchise for the establishment of an electric light plant, and the electric light company retaliated by obtaining from the city council permission to erect gas works. This permission is granted to H. Maxon, W. L. B. T. Allen and Henry Hitchcock of St. Louis. Their application promises to furnish the citizens of El Paso with better and cheaper illumination than is now furnished them. The desired permission was given on condition that at no time in the future should the two rival companies be formed into a mutual trust, after the manner so prevalent in these days.

Greenville, Tex., Oct. 4.—The city council of this place, at its regular meeting, made the final arrangements for a complete system of electric light. The company is composed of three leading capitalists. J. M. Cook of this place, one of the company, says work will begin in a few days on the new enterprise.

Gainesville, Tex., Oct. 4.—A big and novel suit for damages has been filed here in the district court against the Western Union and Santa Fe Telegraph companies. A short time ago G. L. Phillips left his wife sick at her father's home in Palo Pinto county, Tex , and went to Ardmore, I. T., on business. Before going, however, he gave instructions that he should be wired in case his wife grew worse. After her husband's departure, Mrs Phillips grew worse, and a dispatch, notifying him to that effect, was filed with the telegraph companies defendant in this case, and addressed to Mr. Phillips, but the telegram was never delivered. Mrs. Phillips died and had been buried fifteen days when Mr. Phillips returned. He has sued the companies for $10,000 damages. G.

Indiana Notes.

Wabash, Ind., Oct. 5.—At Laketon, in the north part of this county, the house of Dennis Lotzenheiser was struck during a hard storm. The bolt ran around the interior of the structure, tearing off the plastering and reducing everything to chaos. The interior of the building is a wreck, and although a portion of the family were in the house at the time, no one was injured.

Mrs. Catherine O'Brien slipped upon a telephone wire in this city, some months ago, and fractured one of her legs. The wire had been allowed to drag upon the ground. The lady brought suit against the city for damages. This has just been compromised, the corporation paying the lady $100. C

Crawfordsville, Ind., Oct. 6.—This city is now lighted by electricity entirely. For the past three years the center of the city has been lighted in this way, and now there will be seventy lights in operation. A new plant has been installed, with an engine of 230 horse power. The fly-wheel of the engine weighs 16 000 pounds, and is sixteen feet in diameter. C.

Salt Lake City, Utah.

Salt Lake City, Utah, Oct. 6.—The Utah Mining and Reduction company, whose works are located at Bingham, ten miles south of Salt Lake City, are successfully using the new Meech process in the reduction of their low grade and rebellious ores. The ore is passed through a crusher and rolls, crushed to forty-mesh fine, thence into a disintegrating machine, four tons at a time, through a valve, with sufficient water and chemicals to treat sulphur and refractory elements. Steam is then admitted to a pressure of 100 pounds, and at the same time the millers are revolved at about thirty revolutions per minute, generating electricity in such volume as to greatly assist in the decomposition of the ore. This is continued for three hours. The ore is reduced to an impalpable powder, and is thoroughly decomposed and desulphurized. The pulp is now discharged into the amalgamator below, a revolving machine seven feet long and five feet diameter, in which are copper plates placed lengthwise, and by hydrostatic pressure, quicksilver is pressed through the ore. The cost of the treatment is from $2 to $3 per ton. F.

From Cincinnati.

Cincinnati, October 6.—The Cincinnati Electrical Society will hold a public meeting next Tuesday evening. Dr. Otto Moses of New York, will deliver a short address on electrical education, and other addresses of an interesting character will be given. Dr. Moses has been appointed to represent the commissioners of the Centennial exposition on juries for all groups having electrical apparatus. E.

From the Mississippi West

Leavenworth, Kan., Oct. 5.—A company has been granted the franchise and right of way for a district police, fire and messenger service, which is to be placed in operation as soon as the necessary instruments arrive, and wires can be strung. J. D. Hobbs is the superintendent.

Aberdeen, Miss., Oct. 4.—The city council at its last meeting adopted resolutions preparatory to the purchase of an electric light plant and fixtures, and is now in correspondence with electric light companies with that end in view. D.

Pueblo, Col., Oct. 3.—Plans have been completed and the contract has been let for the main building of the new incandescent electric light company It will be 60 by 32 feet, and the plant is to be in operation within three months. There are now over 60 Thomson-Houston arc lights on the streets, and as many more in the business houses.

Los Angeles, Cal., Oct. 2.—James Bothwell, the chief engineer of the electric light company, was seriously scalded a few days ago by a rush of steam from an improperly fast ened plug. The accident is a peculiarly sad one in view of the fact that Mr. Bothwell has within a few weeks lost his two sons, and his wife is ill at the present time. B.

The Aluminium Process.

Editor Western Electrician:

Lockport, N. Y., Oct. 1.—Sir: To Americans belongs the credit for all the advances in the aluminium industry. The Cowles brothers of Cleveland, O., patented the electric smelting processes, and the Cleveland company is the parent company, and not, as you stated in your issue of the 29th ult., the Cowles Syndicate company of England. The only work in the English language on this important subject is from the pen of an American, J. W. Richards, A. M., A. C , department of metallurgy, Lehigh university, Bethlehem, Pa., and the method which cut the price of pure aluminium from $11 a pound to $5—and this happened this summer—is the invention of an American, H. Y. Castner of New York city. S.

THE ELECTRIC LIGHT.

Kirksville, Mo., proposes to have electric lights.

The electric light plant at Lamar, Mo., will be enlarged.

An electric light system will be established at Olathe, Kan.

Peabody, Kan., is calling for electric lights and telephones.

The electric light has been started in operation at Norfolk, Neb.

Electric lights will be established at Marshall, Mo., in a short time.

The Nebraska City, Neb., Electric Light company will put in an incandescent system.

A 100 volt Edison-Swan lamp has recently been exhibited which had a life of 7,100 hours.

The people of Lagrange, Ind., are rejoicing over the brilliant lighting of their streets by electricity.

The California Electric Light company, of San Francisco, will install a plant at Portland, Oregon.

The Imperial Electric Light & Traction company, Montreal, Can., capital $300,000, has been incorporated.

The San Diego, Cal., Gas & Electric Light company expects to have its electric annex in operation about November 1st.

The Thomson-Houston company of Chicago has sold a plant of 50 arc lights and 500 incandescent lights to the Albion, Mich., Electric Light company.

The Paducah, Ky., Gaslight company has made a contract for the machinery for an electric light plant, and will have everything in operation in a few weeks.

Electrical matters at Little Rock, Ark., are booming. The Fort Wayne Jenney, the Edison and the Westinghouse are all on the ground with electric light plants.

The United States cruiser Baltimore, which was launched last Saturday, will be lighted with two electric plants, so that all parts will be brilliantly illuminated by incandescent lamps.

The authorities of Omaha, Neb., have received the following proposition in respect to the public lighting: Thomson-Houston Electric Light company, from dusk until daylight each night in the year, on a five-year basis: 50 lamps, $18 each per month; 100 lamps, $17; same on a ten-year basis; 50 lamps at $16; 100 at $15.25; 200 at $14.50.

W. J. Buckley, manager of the Chicago branch of the Fort Wayne Jenney Electric Light company, has sold an arc and incandescent plant to Swift & Co. for their Omaha packing house.

The Isabella Furnace company, Etna, Pa., have recently increased their Brush electric light plant by purchasing a number of arc lamps from the Brush Electric company, Cleveland, Ohio.

J. W. Sallee, a capitalist of Los Angeles, Cal., who has recently made heavy investments in Clinton, Mo., property, and will establish several new enterprises, has also invested largely in the electric light company.

The Columbia, Tenn , Electric Light & Power company will erect a plant and furnish electric light and power in Columbia as soon as the board of mayor and aldermen pass the ordinance allowing erection of poles, wires, etc.

The Brush Electric Illuminating company of New York has recently ordered 230 2,000 candle power Brush arc lamps for the purpose of increasing its plant. This company is now operating between 2,500 and 3,000 arc lights.

The Greensboro, N C., Gas company has changed its name to the Greensboro Gas & Electric Light company, and will enlarge the gas works in addition to erecting the electric light plant. The capital stock of the new company is $75,000.

The work of erecting the electric light plant at Wauwatosa, Wis., a suburb of Milwaukee, is under way. The plant will include arc and incandescent systems, the arcs to be used for the streets, and the incandescents in lighting residences.

The electric lighting companies of Providence, R. I., have signified their willingness to run conduits through the central portion of the city, if they receive, in return for the city's use of the conduits, an exclusive franchise for a number of years.

The Richmond Electric Light & Power company of Richmond, Va., will erect an electric light plant in Lexington, Va., if permit is granted, and will organize the Lexington Electric Light & Power company to operate the plant. It is reported that Childs & Macmurdo of Richmond, have asked for a permit to erect an electric light plant in Lexington. If granted they will erect a plant to cost not less than $10,000.

Articles incorporating the Santa Monica, Cal., Lowe Gas company have been filed. The incorporators are Wm. S. Vawter and Jessup W. Scott, of Santa Monica, and L. E. Mosher, T. S. C. Lowe and W. C. Callahan, of Los Angeles. The objects of the incorporation are: "To manufacture gas and electricity, and to sell the same; also to manufacture and sell gas and electric machines, and to operate gas and electric motors."

The bids submitted for the right to light the streets of Toledo, O., were as follows: Toledo Gaslight & Coke company—to city, $1.25 per M.; to citizens, $1.35 per M.; contract to last five years. Weston Electric Light & Power company—2,000 candle power arc lights, $84 each per annum. Toledo Electric company—300 arc lights in gas territory, $85 each per annum; 16 candle power incandescent lights, $1 each per month.

The gas company of Lawrence, Kan., has purchased seventy 2,000 candle power Thomson-Houston arc lamps. The lights were started a fortnight ago, and are giving perfect satisfaction. A fine new stone building was erected by the gas company for the accommodation of the new plant. Motive power from the Kansas River will be used for about nine months in the year, but the company has the best of steam power at hand whenever necessary. It is the intention of the gas company to add 1,600 incandescent lights very soon.

Just now Prof. Barrett, city electrician of Chicago, is engaged in rearranging the wires in the Washington street tunnel in order that Mr. Yerkes may proceed to line the hole with steel sheeting. The professor is also placing cables in the conduits to supply the electric lamps for street lighting. Before the new year he expects to have lines in operation on Madison street, from Ashland avenue to the lake; on Michigan avenue, from Rush to Jackson streets; on Halsted street, from Van Buren to Randolph; on Van Buren street, from the bridge to Halsted; on Desplaines street, from Van Buren to Washingtoo, and on Washington street, from Halsted to the tunnel. These are trunk lines, and will be operated by the new plant at the corner of Desplaines and Van Buren streets. Prof. Barrett thinks they will be in use by November 1st. As fast as money can be obtained he will construct spur lines and light other streets. There will be two lamps at street intersections and one in the middle of each block The lamps will be fourteen feet above grade, the posts being of symmetrical pattern, designed in the engineer's office, with an iron base and wooden standard.

Six spar buoys of a novel character have just been completed at the works of the Lighthouse Board on Staten Island. They will be placed so as to mark the sides of the newly dredged Gedney's channel. The peculiarity of these buoys is an incandescent electric light of 100 candle power, which each will carry on its head, to be kept burning nights. On account of the great distance of the Prince's Bay range lights, by which navigators now steer when entering the channel, a bit of bad weather makes an attempt to pass the channel at night perilous, although there will be thirty feet of water over a channel 500 feet wide at mean low water inside of a month. To make the channel safe three buoys will be placed on the north side and three on the south, and to distinguish the side the north range of buoys will have two white buoys with a red one between, while the south range will reverse this order. Each buoy is the trunk of a juniper tree about fifty feet long. The butt is anchored in place by a sinker of iron in the shape of half a globe. An electric cable runs from the East Beacon on the point of Sandy Hook to the six spars. Each spar will stand about

ten feet out of water. The cost of the plant is estimated at between $15,000 and $20,000; the daily expense at about $12. Electricity is used chiefly because a gas lighted buoy would continue to burn after it had been shoved from its place by a field of ice, and thus become a snare. Should ice move these buoys the connection with the shore will be broken. The new form of buoy is the joint production of Lieut.-Commander M. R. S. Mackenzie of the navy and Lieut. John Millis of the army, both attached to the Lighthouse board.

Recently five persons were imprisoned by the caving in of a quarry wall near Perigeux, France, and there was no means at hand to rescue them. To find out where they were, a shaft twelve inches in diameter was bored, down which was slid a tube, near the end of which was a small camera surrounded by a battery of electric lights. With this apparatus a number of negatives were taken, and the effect of the disaster shown, even to the faces of two corpses. It was thus known that the men were dead, and that efforts to succor them would be useless.

The London *Electrical Engineer* says: The passing of the amended electric lighting act seems to be not without avail. Increased activity is arising on every hand, and this season bids fair to be one of the most important in the development of the electric lighting industry in Great Britain. * * * While in America there is hardly a town of 5,000 inhabitants that does not boast its central station, nor scarcely one of 10,000 that has not, at the present time, an electric railway in debate, if not in operation or course of construction, we, in England, have continually been feeling ourselves somewhat left behind in the use of our own inventions and perfections. At last, however, the air clears, and activity begins to show itself all round. We are at least—we may congratulate ourselves—never likely to have to put up with the hideous mixture of posts, poles and wires of all descriptions, hanging in festoons to the imminent danger of the public, too often heard of in America, nor to disfigure our urban streets with innumerable poles; but with the inauguration of the finest systems of underground distribution science can now afford us for our light and our power, and with electric accumulator cars for our tramway service, now, we hope, happily to extend in every direction, we shall not fail to reap in beauty and convenience the reward of our period of waiting for the electric light." This quotation by the way is an apt illustration of the ungraceful way, referred to a week ago, in which English electricians concede American superiority in electrical practice.

THE ELECTRIC MOTOR.

An electric railway will be established at Lafayette, Ind., to run from West Lafayette to Purdue university.

Frank E. Fisher has applied for a franchise for an electric railway from San Jose, Cal., to Alum Rock, a distance of seven miles.

The Sprague company has recently installed a 20 horse power motor for the Iowa Printing company of Des Moines, the largest job printers in the state. This completes the installation of 41 horse power sold by H. O. Woodruff, their Des Moines agent, during August.

Omaha and Council Bluffs will join hands October 30th in celebrating the completion of the new bridge over the Missouri. This structure cost $500,000, and will be used chiefly by pedestrians and vehicles. The railroad bridge crosses half a mile south of the business center of both cities, and does not offer satisfactory accommodation to passengers or vehicles. The electric motor line, built by the Thomson-Houston company of Chicago, however, will cross the new bridge and parallel with and a little north of Broadway, which is the principal connecting street between the towns. The present fare over the railroad bridge is 25 cents. The fare over the new bridge, and from city to city, will be but 5 cents. Motor trains will be run every two minutes. This improvement, it is believed, will prove a great benefit to both cities, and 30,000 enthusiastic Omaha and Council Bluffs citizens will form in parade, walk across the new bridge, ride in the motor, and celebrate generally. The governors of Nebraska and Iowa will formally join the two cities by performing what will be called "the wedding ceremony." Several prominent people will speak.

Reference was made by Mr. Preece in his paper, of which a synopsis was published last week, to an electric mountain road near Lucerne. The London *Daily News* gives this description: Hitherto it has been considered impossible to construct a funicular mountain railway with a curve; but the new line up the Burgenstock has achieved that feat under the superintendence of Mr. Abt, the Swiss electrical engineer. The rails describe one grand curve formed upon an angle of 112 degrees, and the journey is made as steadily and smoothly as upon any of the straight funiculars previously constructed. A bed has been cut for the most part out of the solid rock in the mountain side, from the shore of the Lake of Lucerne to the height of the Burgenstock—1,330 feet above its level, and 2,860 feet above the level of the sea. The total length of the line is 938 meters, and it commences with a gradient of 32 per cent., which is increased to 58 per cent. after the first 400 meters, and this is maintained for the rest of the journey. A single pair of rails is used throughout, with the exception of a few yards at half distance to permit two cars to pass. Through the opposition of the Swiss government each car is at the present time only allowed to run the half distance, and they insist upon the passengers changing, in order, as they say, to avoid collision or accident. I have made a number of journeys up and down the mountain in company with an engineer, and the experience is sufficient to prove that the prohibition is altogether unnecessary. The motive power, electricity, is generated by two dynamos, each of 25 horse power, which are worked by a water wheel of 125 horse power, erected upon the River Aar at its mouth at Buochs, three miles away. Only one man is required to manage the train, and the movement of the cars is completely under his control. One dynamo is sufficient to perform the work of hauling up and letting down the cars containing fifty or sixty persons. At the end of the journey, completed in about fifteen minutes, at an ordinary walking speed, the car moves gently against a spring buffer, and is locked by a lever, without noise and without jolting the passengers. This interesting undertaking has been carried out at a cost of £25,000.

THE TELEPHONE.

The Washington & Union, Mo., Telephone company is rebuilding its line.

The new long-distance telephone line between Boston and Portland has been constructed to within twelve miles of Boston, and is expected to be completed soon.

The Postal & Telegraph administration of Austria has commenced the construction of a long distance telephone line between Vienna and Prague. The telephone line between Alexandria and Cairo will shortly be completed, the last of the apparatus having arrived.

A submarine telephonic apparatus, called the hydrophone, has recently been tested in Brest Bay by order of the minister of marine. The sound of a bell struck under water, was heard at the greatest distance permitted by the configuration of the bay—three miles and a quarter. Excellent results were obtained on board a boat in motion, the bell being distinctly heard a mile off, as well as the noise of the screw of the tug on board which the sounding instruments were placed.

The Bell Telephone company of Philadelphia has commenced the work of putting its wires under ground. Lead-covered cables are laid in wooden boxes under the streets, and the wires are carried to large poles in the center of each block, and from there they are distributed to the several subscribers in that block. A large trunk line is being laid in Market street, from river to river. Other lines branch off north and south on each of the main streets. In nearly all the blocks small streets and alleys provide convenient centers on which to erect the distributing poles. By this system all streets will be freed of wires, as well as roofs of houses, and the network of distribution in back yards and small streets will be so small as not to be objectionable. The ordinance authorizing the laying of these underground wires and erection of poles requires the removal of all overhead wires within five years, but the company expect to complete the work sooner than that.

The Baltimore *Sun* of September 19th says that late Monday night while Thomas Murray, the night telephone man of the central police station, was receiving the hourly calls of the sergeant, he placed his hand on the switchboard and received such a shock that he cried out with pain. Commissioner Gill, with Sheriff May and Captain Farnam, were present at the time. The captain placed his hand on the same board and received a terrific shock. His arm began to swell and he could not pull it away. He was finally pulled away by several policemen. Sergeant Shoemack, who was in the act of pulling in a call from 123 box, Gay and Second streets, at the time, received a shock which threw him to the pavement. He thought he had been shot. Mr. Rutter, the telegraph man of the department, made an investigation and found that an electric light wire had fallen on the telegraph line at the corner of Hanover and Pratt streets, and had caused the trouble.

The officials of the Subway board claim that the telephone people are finding in the subways a partial remedy for the greatest trouble that has been experienced in the use of the telephone in this city—the induction from other wires with stronger currents passing near the telephone wires in the air, says the New York *Sun*. This causes the buzzing and crackling sounds that make it nearly impossible to use the telephone in this city with any degree of accuracy or satisfaction. It is easier now to talk with Philadelphia or Boston by telephone than to carry on a conversation over the wire with a man a few blocks away in this city. If the subways will make it possible for New York to have as satisfactory a telephone service as is enjoyed in most towns of a few thousand inhabitants anywhere within 1,000 miles of here, the use of the telephone will be greatly increased. At present few make use of it any oftener than they are compelled to, on account of the nervous strain incident to discovering whether the person being talked with is answering your question or making warm remarks on the damfoolishness of these blamed machines.

Says a Paris correspondent: In 1886 the minister of posts and telegraphs granted to the Societe des Telephones, for thirty-five years to come, the concession of all the telephone lines then in existence or to be afterward constructed. This concession placed a serious obstacle in the way of the development of the telephonic system, and the government authorities have lately been pressed to seek some means for remedying the evil. An effective step in this direction has just been taken. M. Coulon, the director general of posts and telegraphs, has addressed to the departmental directors of his administration a circular relative to the construction of new telephone systems in towns. After setting out the actual situation of the urban state telephone systems, in which the subscribers pay an annual rent of 200 francs, plus the cost of the apparatus and erection, charged for at the rate of 150 francs per kilometer of wire, the circular points out the method of procedure in the case of new urban systems. For all towns which shall apply for it, the government authorities shall draw up plans and estimates of the cost of erection and maintenance till the year 1890, and if the municipal authorities are willing to advance the money, the state will execute the work. The town will then be allowed to repay itself this advance by collecting the subscriptions till the sum is made up. In short, each town controls its own telephone system, the municipal budget provides the necessary funds, and these are repaid by the subscribers' rents.

THE TELEGRAPH.

The Chicago court records in the history of the Great Western Telegraph company received another contribution last week in the filing of a bill in chancery in which Charles B. Farwell, David B. Fisk, Charles M. Henderson, James L. Collins and Henry C. Burgie, stockholders in the concern, in fifty-three printed pages set forth in detail the alleged fact that through corrupt combinations between certain other of the stockholders, attorneys and others, collusion with the Western Union Telegraph company and conspiracy between ostensibly opposite parties in interest, various accountings and judicial decrees have been obtained to the unjust advantage of the conspirators and to the damage and detriment of the complainants. The bill prays for a summons commanding the appearance in court of the Great Western Telegraph company, Selah Reeve, David A. Gage, Josiah Snow, Jeremiah M. Terwilliger, and others, defendants, with the stock subscription list and all papers, contracts and documents relating to the business of the corporation, to the end that a full and correct accounting may be had, the former decrees set aside as illegal, collusive and fraudulent, and the equities of all stockholders and claimants determined.

A recent issue of the Detroit *Free Press* contains a story of a telegraph operator in a lonely railroad station in the far west—a theme by the way which is becoming quite popular. It is fictitious, of course, but it is interesting notwithstanding the fact that parts of the story are not quite clear to electricians. The story opens with the operator covered by the revolver of a robber, who orders him to send over the wire a message which will cause the fast express with its immense amount of valuables to stop at the station. The operator sends a message stating that the shanty is in the possession of the villain and his companions, and asking that a sheriff's posse be sent to capture them. The outlaw's comrades are outside the station and the question in the operator's mind is how to get rid of the one who is covering him with a revolver, so he telegraphs, "Can you make a connection with the town arc light and get them to put their full current on? I'll connect it in some way with the fellow here, and he'll never know what struck him." There was an objection made to this course, but the answer is returned: "I can give you all the current we have here, and that will paralyze any rough from Zama and perhaps kill him. Anyhow, you could get his gun before he recovered. When you're ready just call the office. Ground your current and I'll send it along on the —— wire." The telegrapher went to a drawer and took out a piece of wire and to one end attached a pair of scissors. The other end he connected with the big wire from Bottomville. He fussed around the switch board and then took a pail of water and said: "Look out for your feet. I must damp down the floor, so that there will be no dust to interfere with the instrument." The desperado was asked to hand the operator the scissors. He complied. The outlaw reached for the scissors and the next instant with a yell he sprang toward the ceiling and fell in a heap on the floor. The train robbery was prevented, the outlaws were gathered in and the operator was a hero.

Personal Paragraphs.

Assistant Manager Proal, of the Baxter Electric Manufacturing & Motor company, Baltimore, was in Chicago the first part of the week.

The death of Wm. Baragwanath of Chicago, known by name at least to every large steam user in America, was recently recorded. He was the inventor of the Baragwanath heater.

C. F. Annett, general manager of the Rocky Mountain Bell Telephone company, and president of the United Electric company, Salt Lake City, was welcomed by his many friends in Chicago, this week.

Miscellaneous Notes.

The capital stock of the Central Electric company of Chicago has been increased from $10,000 to $50,000.

A manhole cover was blown off a conduit at the corner of Adams and Clark streets, Chicago, Friday, October 5th.

A statue in honor of Ampere will be dedicated at Lyons, France, during the present month. President Carnot has promised to attend the ceremonies

At the annual meeting of the American Society of Mechanical Engineers, which will be held at Scranton, Pa., October 15-19, C. J. H. Woodbury will read a paper on electric welding.

The Dieckmann Electrical company of Chicago has been incorporated, with a capital stock of $100,000. The company will manufacture electric machines and apparatus. The incorporators are G. F. Dieckmann, Christian Wahl and David Quigg.

An expert in the employ of a firm of bakers of London has been experimenting during the last twelve months with the object of discovering a method of baking bread by electricity, and, it is said, has been quite successful after a great deal of labor. The bread is said to be quite as well baked as by the present methods and more quickly, while there will be a very considerable saving in expense.

A dispatch from Ansonia, Conn., says: The article concerning the beneficial effects of electricity upon rheumatic people has received strong confirmation in the person of Mrs. Moses Stickney of Woodbridge, a few miles from here. Mrs. Stickney is past the middle age, and has for years been a sufferer from muscular and inflammatory rheumatism. One evening last week she was sitting in her kitchen during a heavy thunderstorm, when lightning struck the chimney of her house. It followed the stovepipe to the stove, popped out on to the floor, and darted across to the iron water pipe in the sink. In its passage across the floor it went over Mrs. Stickney's feet, leaving a slight

red mark, and giving her quite a shock, but not one strong enough to render her insensible. In her excitement she jumped up and ran to another part of the house, something she had been unable to do for years, and from that time she has been able to walk without difficulty, and has not experienced a single rheumatic twinge. She ascribes her cure to the lightning, but thinks it a severe remedy.

It is be noticed in several interviews quoted is a daily newspaper that a materia lincrease in the Chicago motor service is predicted. As the merits of the electric motor become known its use is bound to be wonderfully extended. The fact seems to be that its advantages are not properly appreciated. Small users of power do not understand the action of the motor, and as a result they are afraid of it. They imagine it is unreliable. The satisfactory working of the service, however, is bound to have its effect and to make it universally popular. As the London *Electrical Engineer* says, "It is clean, noiseless, compact and cheap. This is the sort of character for a go-ahead article."

In spite of the thousands of miles of wires that subway reports and other documents assert have been put underground within a year or two past, the poles and the overhead wires still remain, says the New York *Sun*. They are not only not being taken down, but in some parts of the city miles of new poles and wires are going up. Apparently the electric companies are simply using the subways as a convenient means of extending and enlarging their systems, and are keeping up their above ground facilities just the same. If so it becomes an interesting question whether the subway system will ever catch up with the electric systems, and whether the subways, instead of relieving us from the poles and wires that are and have been, are only to relieve us from those that might have been.

In discussing the subject of lightning conductors at the British association meeting, W. H. Preece said that lightning produced sounds. He had stood near a telegraph office and he had heard distinctly letters of the alphabet signaled by a flash of lightning. He had introduced into his presidential address this quotation from Job: "Canst thou send lightnings that they may go and say unto thee: 'Here we are'?" Now, he had heard the letter "R" most distinctly sounded. Mr. Preece was asked il he had heard the three "R's". He said, "Only the first R—we have stopped at that. Now, the letter R involved three currents—three oscillations were required to make it. He had also heard the letter C; that involved four currents. There was a case on record in the A B C instrument of Wheatstone of the letter G having been made. Now, the letter G required eight alternations to be made, in order to be recorded."

It is stated that George Westinghouse has invented a new system of signals designed to render collisions between trains impossible. The Pennsylvania's block system, which is 500 miles long, costs $600,000 a year to maintain it, while the new system can be operated for $100,000 a year. It consists of a pair of steel springs fastened to the rail at each end of the tunnel, which, being compressed by the wheels of a train at one end of the tunnel, cause the breaking of an electrical circuit. This causes a red danger signal to appear in a glass bull's eye on the top of a ten-foot pole beside the track. Every wheel which passes over the springs breaks the current and is counted by electricity. Before the danger signal is withdrawn the same nnmber of wheels must pass over a similar pair of springs at the other end of the tunnel. It is claimed that this system will afford absolute protection at drawbridges, switches, and all dangerous points where signals are required.

One of the most pleasing features of the recent fair of the R. R. Y. M. C. A., at Fort Wayne, Ind., was the exhibition given by the Jenney Electric Light company. A 5,000 candle power electric headlight illuminated the platform. Sewing machines were run by motors Glass blowers were at work. Eggs were boiled in water heated by electricity. Two operators were present who explained the working of the apparatus to the visitors. An alternating current motor was exhibited. A local paper speaking of the exhibit, said: "Every patron of the fair can find an instructive and pleasurable half-hour by entering these scientific parlors. The compartment is divided into three rooms. In the extreme right a motor is in motion by power received from the current of the arc circuit, and the incandescent machine evolves light throughout the entire apartment, and also supplies the power for the small motor running sewing machines. The center room, handsomely furnished and representing a drawing room, is exquisitely illuminated by the incandescent light The third apartment contains electrical apparatus of all kinds—marvels of minuteness and skillful workmanship."

Boston people nowadays have their superfluous teeth drawn by means of electricity, says a correspondent of the St. Louis *Globe-Democrat*. Inasmuch as all new ideas in the arts and sciences are spread from this enlightened metropolis originally, and from thence extended over the country, there is little doubt that sooner or later this new method will supersede laughing gas and ether in other big cities of the Union. The process in question is very simple, scarce any apparatus being required beyond an ordinary two cell battery, with vibrator attachment. This attachment is a thin strip of metal, fastened at the ends, which is made to vibrate a thousand or more times per second by the electric current. At each vibration the circuit is cut off and renewed again, the effect being to give a perfectly steady flow of the mysterious fluid. In order to make sure that the flow is quite satisfactory the operator tunes the machine—assisted by a little reed tuningpipe—until the strip of metal sings "A." So far, so good. Now to the battery are attached three wires. Two of them have handles at the ends, and the third is hitched to a forceps. The patient in the chair is given a handle to hold in each paw, and the current is turned on gradually until it becomes painful. Then he is told to grasp the handles as strongly as possible, the electricity, having been switched off for a moment, is turned on again suddenly, and the dental surgeon applies his forceps simultaneously to the tooth. The instant the molar is touched, it, as well as the parts surrounding, becomes electrified and absolutely insensible to pain. When it is withdrawn from the socket, the subject of the operation feels not the slightest disagreeable sensation. A jerk and the tooth is out, the patient drops the handles and the affair is over. This invention comes just in time to take the place of the unsatisfactory nitrousoxide, or "laughing" gas, as a dental anæsthetic. The latter is about as likely to cause painful effects as pleasant ones, some persons being afflicted with the most frightful visions and delirium while under its influence. Besides, frequent indulgence in it is dangerous. It was only a year ago that an expert tooth puller here was reduced to the condition of a raving maniac by a habit he acquired of inhaling the stuff from a rubber bag and going off into prolonged trances. It was said that, toward the end he was accustomed to take it in a liquid form, transformed into that shape by a pressure of goodness knows how many atmospheres. However, it is something in this wicked world to say that one has discovered a new vice.

We were shown this week what looks to be a practical electric motor for tricycles, says the *Bicycle World*. It weighs but twenty-five pounds, can be easily attached to any machine, and has one-eighth horse power. We do not doubt it will drive a tricycle, but it has the objection that all storage battery motors must have, and that is, that it will run but three hours, when it must be re-charged at some place where there is a dynamo. It must be remembered that dynamos do not grow on every bush, nor does every village boast one, and the unlucky wight who finds his battery run down when he is ten miles from home will have to carry the twenty-five pounds of dead weight. Moreover, if he should find a dynamo close at hand, it will require just as long to charge the battery as it will afterwards run. The plan contemplated is to have batteries ready charged at electric stations, and a quick transfer can be easily made. The perfection of the plan is, we are afraid, a long way in the future.

At a special meeting of select council of Philadelphia, held on the 27th ult, a resolution was presented asking for the appointment of a joint special committee to inquire into the cost of lighting the city by the electric light companies having contracts. The preamble says that the city pays $129,000 per year for 755 electric lights, and that it is openly asserted that this charge is excessive; that the companies are under contract to furnish arc lights of not less than 2,000 candle power, and that it is also asserted that these lights are of not more than 1,200 candle power, and that for $300,000 a fully equipped plant could be erected to supply from 2,500 to 3,000 lights at an annual expense of not more than $90,000. The resolution was adopted, after a statement by Mr. Graham, chairman of the electrical committee, that the Bureau had under consideration a plan for the erection of a city plant, which it had only been deterred from making public until it had found the source from which the $400,000 estimated to be necessary could be derived.

Business Mention.

Chas. A. Schieren & Co., of New York, report recent sales of their new electric perforated belting for use on dynamos to the following electric light companies: Allegheny County Light company, Pittsburgh, Pa.; Scranton Illuminating Heat & Power Company, Scranton, Pa.; Framingham Electric company, South Framingham, Mass.; Electric Light, Heat & Power company, Carbondale, Pa.; Jenney Electric Light & Power company, Indianapolis, Ind.

The American Leather Link Belt company reports sales of their leather link belting during the past week to the following concerns for use on dynamos: Sheffield Electric Light works, Sheffield, Ala.; New Bedford Gas company, New Bedford, Mass.; Clark Electric company, 159 Chambers street, New York city, belt to run on dynamo at American institute fair; Robert B. Suckley, Orange, N. J.; Solvay Process company, Syracuse, N. Y; Colchester Rubber company, Colchester, Conn; Congaree Manufacturing company, Columbus, S. C.; two 10-inch link belts to run on Waterhouse dynamos at American institute fair, New York; Electric Light & Power company, Montpelier, Vt.

Electrical Patents.

Issued Oct. 2, 1888.

390,196. Device for Protecting Electric Conductors. Edward G. Acheson, Pittsburg, Pa.

390,229. Magnetic Cleaning Apparatus. Alwin Hempel, Dresden, Saxony, Germany.

390,230. Apparatus for Synchronizing Clocks. Charles E. Hoefling, London, County of Middlesex, England.

390,245. Electric Arc Lamp. Richard H. Mather, Windsor, Conn

The lamp is of the ordinary friction clutch type. An electro magnet, whose armature is a compound wound solenoid, is used to control the feeding mechanism. The fifteen claims are limited to the details of construction.

390,301. Armature Core for Dynamos. Warren S. Hill, Boston, Mass.

The core is composed of a series of disks having side flanges, said disks being secured upon a shaft, coils of iron wire supported by said flanges, insulating material between the coils and the disks and the flanges, said flanges being perforated.

390,310. Electrical Testing Apparatus. James W. Packard, New York, N. Y.

The second claim reads: "2. In an apparatus for electrical testing, a Wheatstone bridge having an ascertained resistance in one of its branches, while the circuit through its second branch and the circuit through its galvanometer are normally broken, together with a cut-out, which, by one motion of the lever, simultaneously closes the galvanometer circuit and introduces into the second branch of the bridge the unknown resistance which is to be tested, all in combination."

390,318. Alternate Current Dynamo. Elihu Thomson, Lynn, Mass.

The invention relates to a generator having two sets of armature coils, both on the same armature structure, one of which is connected directly to the external circuit, for supplying alternating currents from the machine, and a commutator placed between the other set of armature coils and the field exciting circuit for rectifying the currents supplied from such second set of coils to the field magnet or magnets.

The invention consists in the manner of combining the two sets of armature coils on the same armature structure, one set being the field-maintaining set, and the other the working current or line set. "Claim 4. The combination, with flat armature coils applied to the periphery of the armature, of independent coils wound over the armature body and in the spaces in the center of the first-named coils."

390,329. Electric Circuit Controller. August F. L. Willatowsky, Stamford, Conn.

390,354. Galvanic Abdominal Truss. Louise Epple, Chicago, Ill.

390,413. System of Electrical Distribution. Nikola Tesla, New York, N. Y.

The second claim reads: "2. The combination, with a generator having independent current generating circuits and a converter or converters having independent and corresponding circuits, of independent line or connecting circuits formed in part through a conductor common to all."

390,414. Dynamo Electric Machine. Nikola Tesla, New York, N. Y.

The first claim reads: "1. A dynamo or magneto electric machine or motor, the frame of which is built up of two castings, each consisting of end plates with pole pieces extending inwardly therefrom, and connecting side bars."

390,415 Dynamo Electric Machine or Motor. Nikola Tesla, New York, N. Y.

The frame is built up of two castings, each consisting of end plates, with pole pieces extending inwardly therefrom, and having connecting side bars.

390,428. Telephone. Parvin Wright, Denver, Col.

The invention consists in providing a telephone with an electro magnet, the coils of which are included in an electric circuit, and providing resistance devices in an independent circuit to vary their conductivity.

390,439. Dynamo Electric Machine. Charles S. Bradley, Yonkers, N. Y.

390,440. Storm Protector for Electric Lamps. Thomas H. Brady, New Britain, Conn.

390,462. Process of Making Carbon Filaments. Thomas A. Edison, Llewellyn Park, N. J.

The process consists in forming two or more filamentary blanks for carbonization by cutting from a natural fibrous vegetable material, lengthwise of the fibers thereof, a strip of the length of two or more of such blanks, reducing such strip to the proper filamentary size, carbonizing such blanks together under the same conditions, and dividing the blank transversely into two or more blanks before or after carbonization.

390,463. Distribution and Control of Electricity for Lighting. Henry Edmunds, London, England.

The method claimed consists in arranging the batteries at each station in groups or sets, and transferring each group or set in turn from the working circuit into the charging circuit for short periods of time without short-circuiting the batteries or breaking the charging or working circuits, so that all but one of the groups or sets are in the working circuit at any instant of time.

390,464. System of Utilizing Secondary Batteries. Henry Edmunds, London, England.

390,481. Electric Light Circuit Cut Off Switch. William A. Johnson, Toronto, Ontario, Canada.

390,544. Therapeutic Electrode. James H. Woodward, Seward, Neb.

390,575. Telephone Transmitting Instrument. Robert D'Unger, Chicago, Ill.

The object of the invention is to provide a transmitting instrument for long distance communication, and consists in applying the principle of leverage to increase the effect of the vibrations of the diaphragm; also in a means of adjustment of the microphonic contacts, and in certain other details of construction.

Claim 4: "The combination of the diaphragm, the contact pencil vibrated thereby, the hanging pencils resting against the first mentioned pencil, and the cranked rod upon which said hanging pencils are hung to adjust their pressure against said first mentioned pencil."

390,597. Porous Cup for Galvanic Batteries. Ernest M. Hewett, Newton, Mass.

The invention consists in a porous cup for a battery sized interiorly or exteriorly, or both, with a coating of gelatinous material, rendered insoluble by the application of chrome alum or chromic acid.

390,619. Apparatus for Removing Ice from Railway Tracks. Elias E. Ries, Baltimore, Md.

The invention consists essentially in equipping the central or supply station with a source of electricity, furnishing currents of comparatively low tension and heavy heating capacity, and connecting said source of currents in the supply circuit extending from the generator or generators producing the normal actuating current, so that the source normally supplying the high potential motive current may be periodically disconnected from the line, and the source furnishing the heating current may be placed in circuit with said line.

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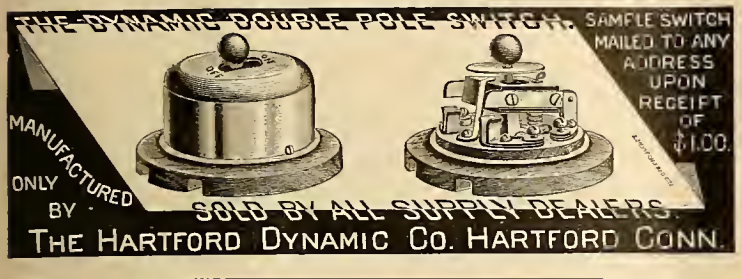

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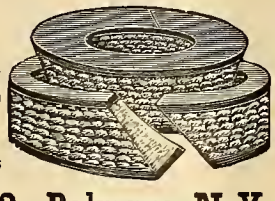

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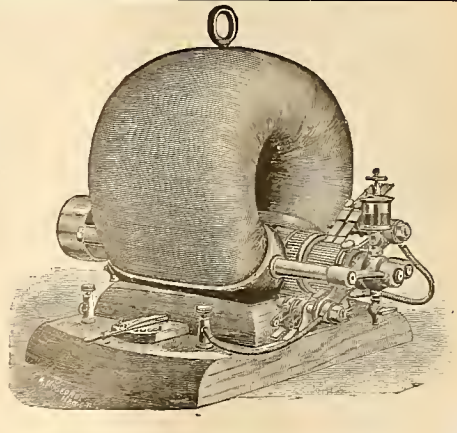

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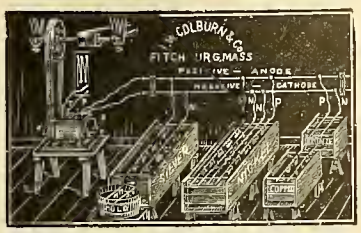

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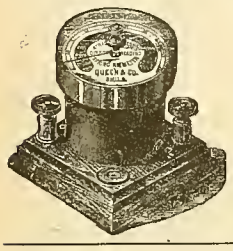

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The successful bidder will be required to enter into good and sufficient bond, of such penalty as the Mayor and Aldermen shall hereafter fix, conditioned that he will erect and have ready for use the electric plant, and begin the lighting of the city therewith, on the dates hereinbefore stated.

The Mayor and Aldermen reserve the right to reject any or all bids.

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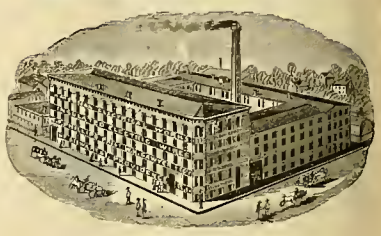

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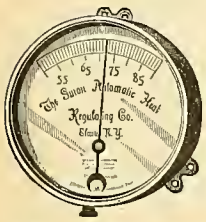

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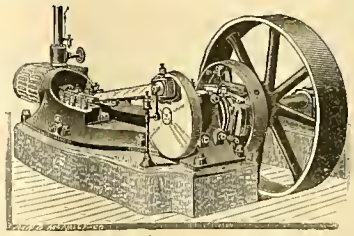

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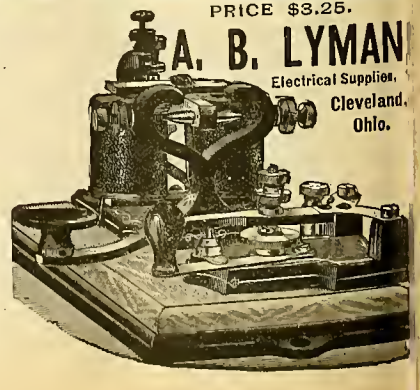

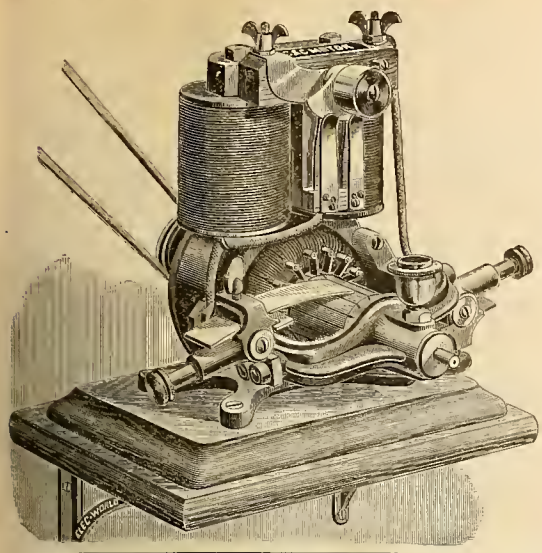

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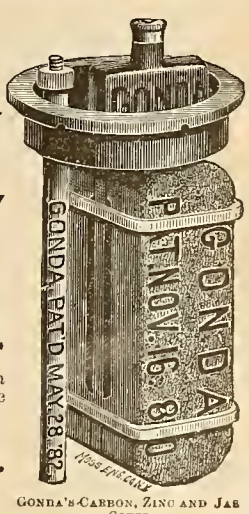

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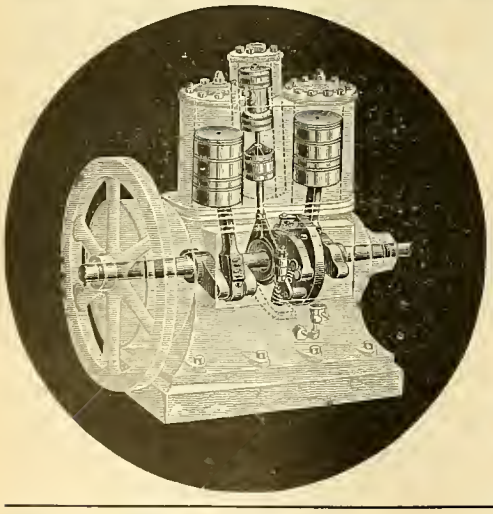

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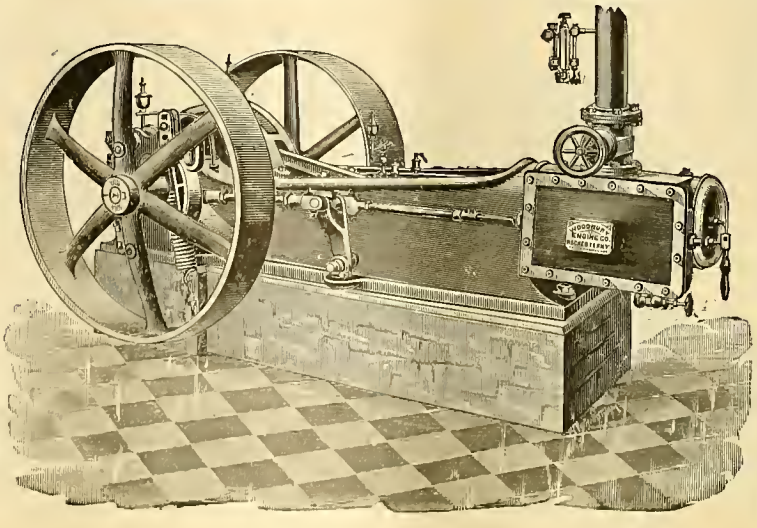

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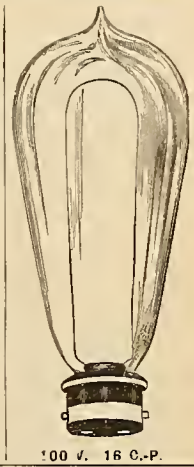

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WE ATTEMPT A SPEECH.

[OUR MAIDEN EFFORT.]

Please picture us as having taken off our hat, made our bow, smiled, put our left hand in our pants pocket, taken an easy position before an electrical audience (when we say "electrical" it is unnecessary to add "good looking and intelligent"—*that goes*), and proceeding as follows:

GENTLEMEN:

We did not expect to be called on to address you, but as it is your wish that we should do so, we will try and overcome our natural modesty and make a few rambling remarks on *Electricity in the Household.*

We think that this is a field which electrical men have somewhat overlooked. We do not think that you have yet realized the money there is in it, and what a handsome profit a little energy and push on your part would earn for you in your own neighborhood. You do not seem to realize that the wonders of electricity are talked of at every fireside—that not one out of every hundred houses in your city, town or village, has an electric bell, and that every one of your neighbors is thoroughly ashamed of that old-fashioned crank bell in his hall way. Take, for instance, your neighbor Smith; now you all know that Smith is a liberal, good hearted fellow, that he has plenty of money and is not afraid to spend it, that he often "blows in" ten or twenty dollars in one evening with the boys, and yet—Smith has an old-fashioned crank bell in his hall, Mrs. Smith has a cow bell on her dining table, and, in fact, as far as practical benefits go, Smith knows no more about the everyday comforts he might derive from electricity than Eve knew about a sewing machine. Now, who is to blame for this? Not Smith, but yourselves. Why don't you explain to Smith what could be done and what an improvement it would be.

We would also remind you that in order to make a success of this business you must use good material and do good work. Don't attempt to put a ten-cent push button in front of a five, ten or twenty thousand dollar house; don't use bells which are neither ornamental nor useful; don't use batteries which are liable to play out at any time; don't send a boy who knows nothing at all about what he is doing, to do a job which should have your personal supervision. Better charge twenty dollars and do a job well and with good material than ten or five dollars for a botched affair. Your neighbors are willing to pay a fair price for good work. We think it is necessary for you to have a small stock on hand in order to properly demonstrate what you propose doing. What would you think of a dry goods man, or a grocer, or boot and shoe man, who tried to do business and take orders without even a sample to show? You would not think much of his business method, and he would think he was not making money very fast. Are not some of you trying to get orders for electrical work without even a sample stock of electrical goods? What is the reason of this, gentlemen; are you hard up, or do you not have faith enough in your own business to stock up? If you have not, you had better give it up. You cannot successfully preach what you do not believe. We are at present manufacturing electrical goods and shall continue doing so as long as you want us to. We do not compete with our customers in any way by doing electrical work. We do not put in electric bells or do any electrical wiring, and do not intend doing so. When we find that you do not appreciate first-class electrical goods at very low prices we will turn our attention to the manufacture of spring beds, baby carriages, campaign poetry, or something else which we think you all fully appreciate. In conclusion, will you allow us to call your attention to our catalogue number 645. You will find our goods exactly as illustrated, and prices very low. If you do not see a good opening for business in your neighborhood, please write us; it must be a very peculiar place, and we would like to hear all about it.

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7. We want to exchange our goods for money. We do not wish to give them away. Cash or security seems a fair proposition.

Trust we have not wearied you, for the present, adieu. Order often.

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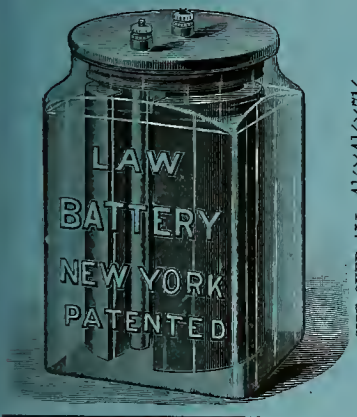
THE LAW BATTERY.



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FOR ALL CLASSES OF OPEN CIRCUIT WORK.

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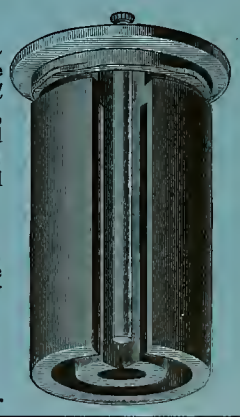

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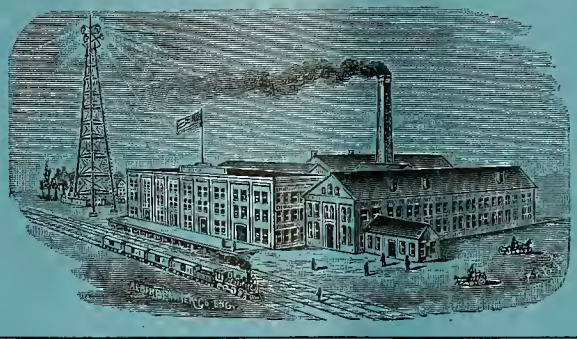

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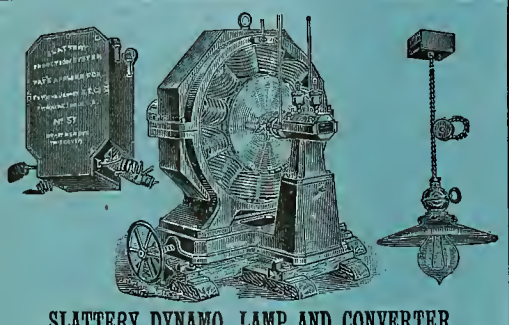

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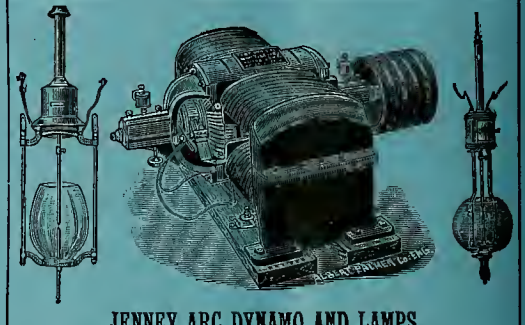

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We have had very little, if any trouble with it, and our expense for repairs has been nominal, in fact, we are so well pleased with the Van Depoele Electric light system, after using it five years, that we purchased an additional plant from you last Fall.

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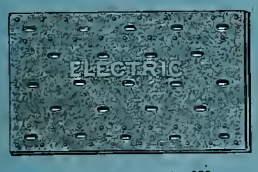

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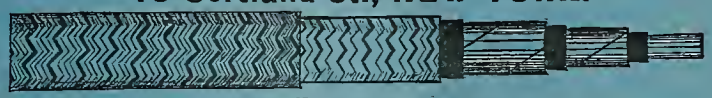

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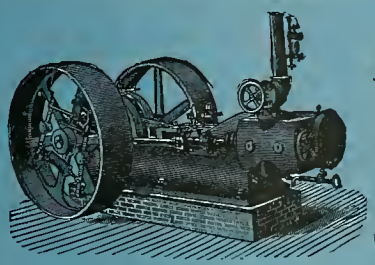

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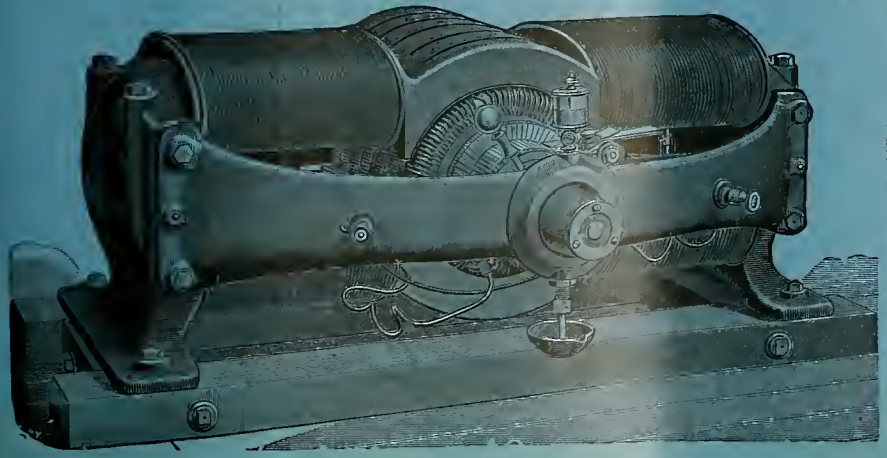

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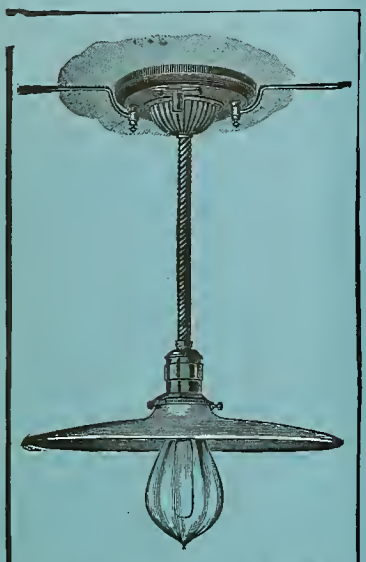

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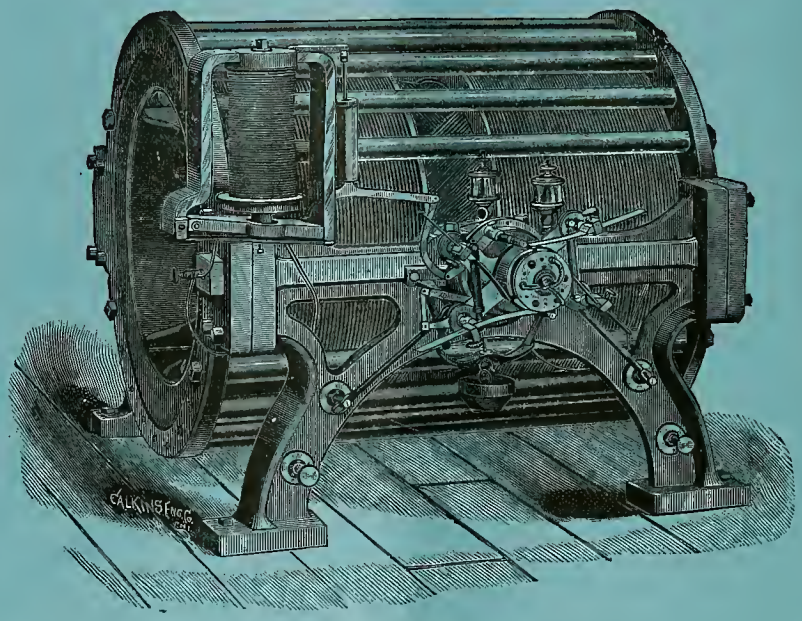

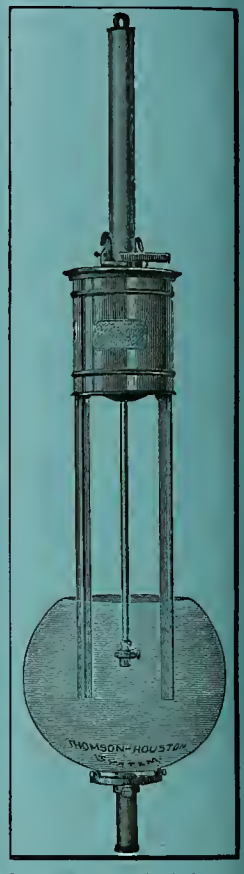

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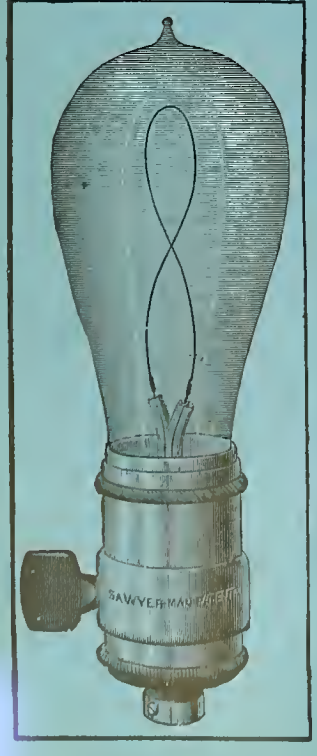

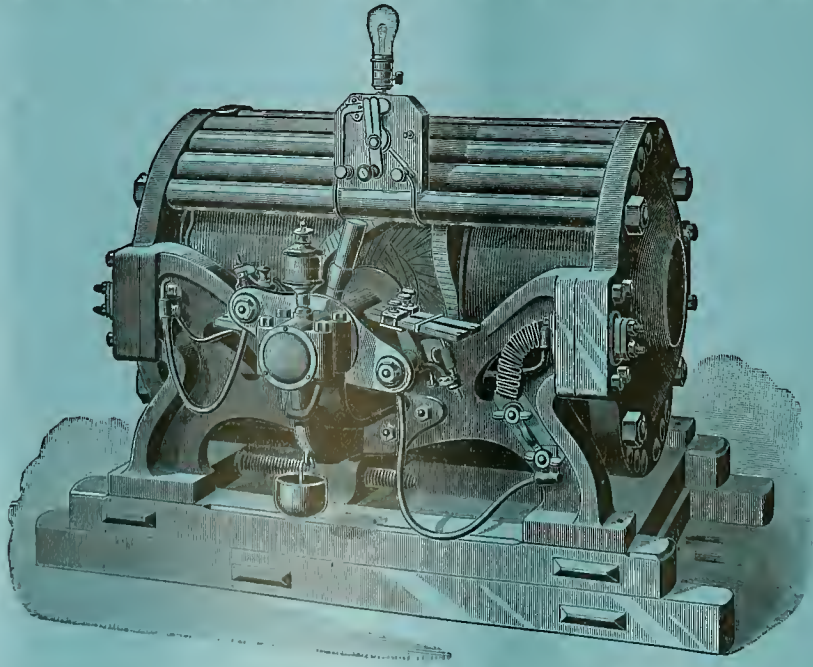

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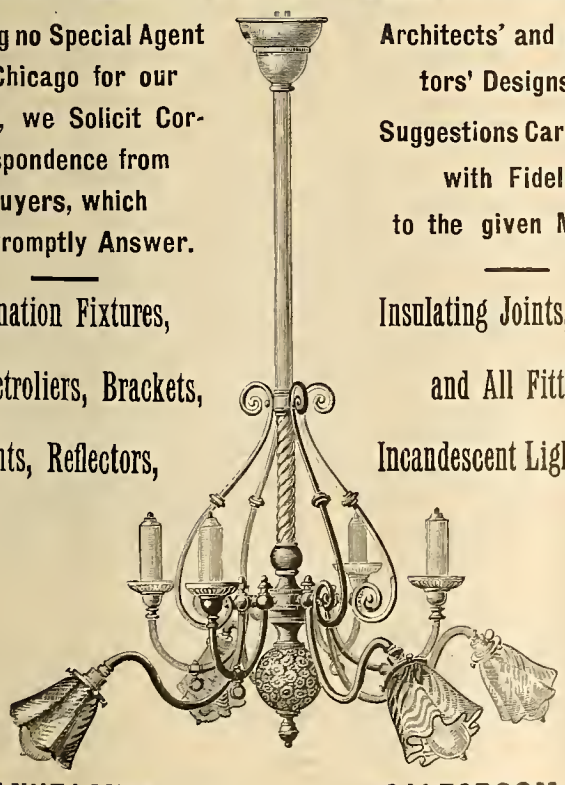

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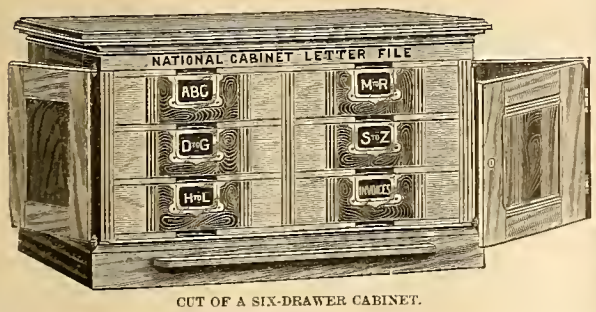

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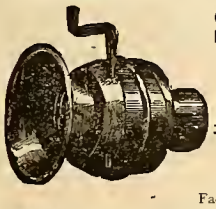

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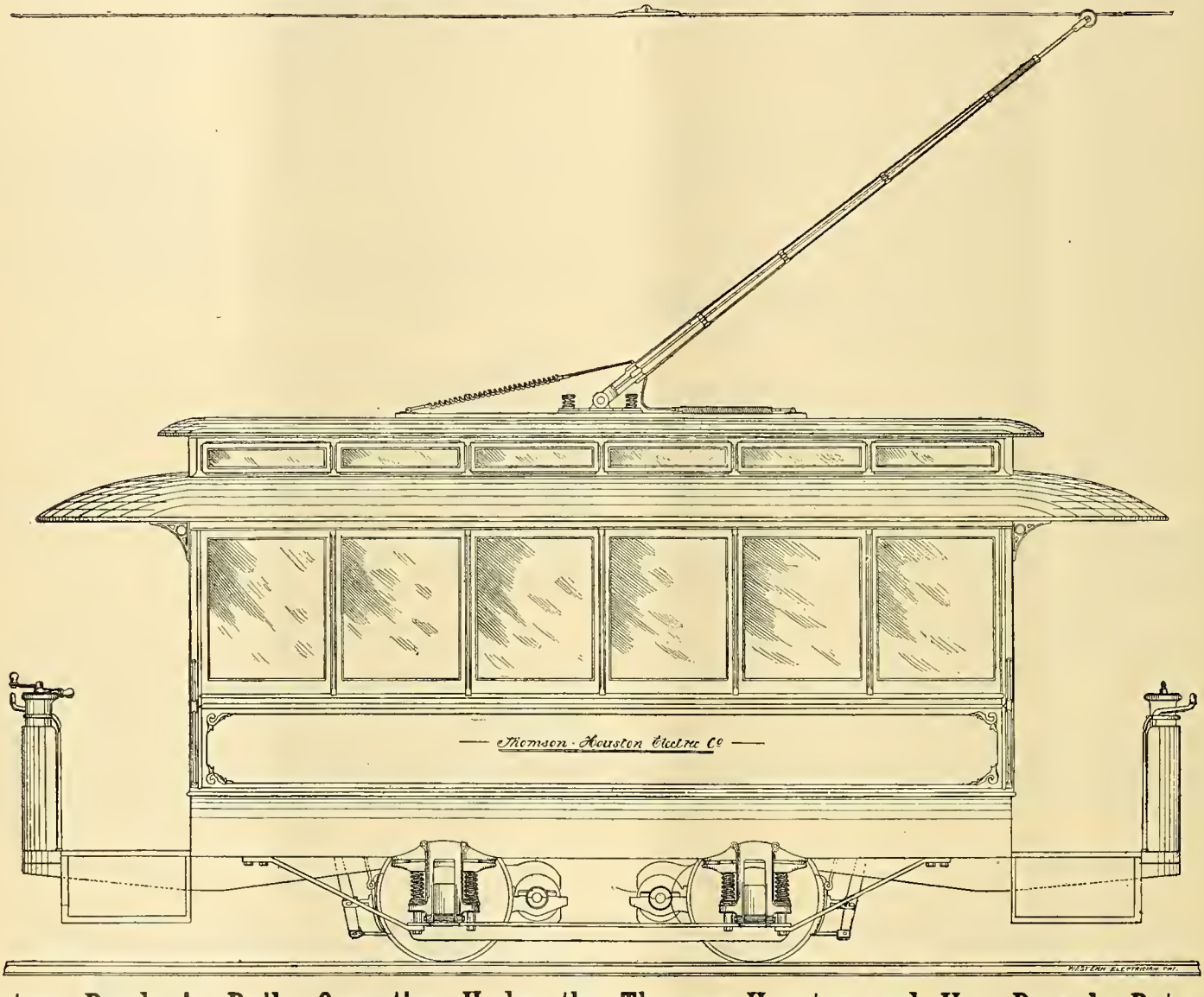

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It measures the whole current.

It is strictly a positive mechanical movement.

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All parties desiring to secure the most perfect system of electric distribution for light and power are invited to inspect the apparatus at the works of the company at Pittsburgh, Pa., where it will be demonstrated that the Alternating System possesses such advantages over the direct system in regard to efficiency, distribution, safety, life of lamps, and the use of meters and motors, that no purchaser can afford, at any price, to take the direct current apparatus.

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Vol. III. CHICAGO, OCTOBER 20, 1888. No. 16.

A New Eighteen-Light Dynamo.

C. E. Jones & Bro. of Cincinnati, O., have designed the new incandescent dynamo of 18 lights capacity, illustrated by the accompanying cuts to meet the want for a small dynamo capable of supplying from ten to twenty 16 candle power lamps in offices, stores, show windows, residences, mills, factories, foundries or any place where only a few lights are required, and where the small amount of power necessary to run it may be obtained. This is the primary purpose of the manufacturers, but taking cognizance of another want, i. e., of amateurs who would be only too willing to go into experimental work and perform the labor themselves, provided they had the material, and the willingness of manufacturers to perform the machine labor on castings provided they could have them without going to the expense of making the patterns, C. E. Jones & Bro. have determined to sell the component parts of this dynamo or any portion of them with the machine work done or the castings left in the rough, as may be desired. To this end they are preparing illustrated directions for those who wish to do the work themselves on the parts furnished by the manufacturers. The subject is an interesting one and will undoubtedly be referred to hereafter in these columns.

Fig. 1 of the illustrations in connection is a perspective view of the completed dynamo. Fig. 2 shows the elevation at the commutator end. Fig. 3 shows a vertical section through the middle. Fig. 4 is a side elevation, and Fig. 5 shows the rheostat or resistance box for maintaining a constant electromotive force.

One single gray iron casting includes the base plate, field magnet cores, together with their neutral yoke or heel piece; and the stands at either end of the base which support the journal bearings, Figs. 3 and 4. The field wire is wound upon sheet metal spools or shells, which are then slipped over their respective cores. The pole pieces are bolted to the tops of the cores by the large bolts shown in Fig. 3, passing down through the pole pieces into the magnets.

The tops of the bearing stands are planed, and have the journal boxes bolted to their turned surfaces. These boxes are carefully babbited to a standard mandrel, and have oil ways cored in them to carry away the waste oil. A brass tube is fitted into this cored hole to lead the oil away. This feature is shown in Fig. 4.

A heavy cast brass plate is firmly secured by means of screws to the tops of the pole pieces, firmly retaining the parts in their correct positions, as well as adding to the finish and appearance of the machine, as shown in Fig. 1.

When run to its full capacity the dynamo generates 16 amperes at 70 volts.

The machine requires about two-horse power to drive it with its full capacity of eighteen lamps, and shows an electrical efficiency of a little more than 82 per cent.

It requires from 1,900 to 2,200 revolutions per minute to develop its full capacity. Each machine is tested and the required speed stamped upon it.

The weight of the machine complete is 200 pounds, and it occupies a floor space of 20 by 14 inches.

The size of the pulley is four and a half inches in diameter by two and a half inches face, and the belt is two and a half inches wide.

The dimensions of the machine follow:

Height over all	14	inches.
Length of magnet cores	7½	"
Length of wire space on magnets	7¼	"
Depth of wire space on magnets	⅜	"
Diameter of magnet cores	4	"
Size of wire on field magnets, single cotton covered, Number 18, B. & S. gauge		
Weight of wire on field magnets	33	pounds.
Number of layers deep on field magnets	16	
Number convolutions per layer	150	
Length of field wire on both magnets	6720	feet.
Diameter of bore at pole pieces	3 3/32	inches.
Diameter of armature core plates	3	"
Number of armature core plates	90	
Thickness of each armature core plate	.045	"
Thickness of paper insulation between core plates	.004	"
Thickness of cast iron plates at each end of armature core	¼	"
Length of armature core	6	"
External diameter of armature	3½	"
Size of wire on the armature, double cotton covered, Number 16 B. & S. gauge		
Number of convolutions to the coil	10	
Number of coils on armature	24	
Weight of wire on armature	3¼	lbs.
Weight of armature complete	16½	"
Length of shaft	21	inches.
Diameter of shaft at bearings	⅝	"
Diameter of shaft at armature core	⅞	"
Number of commutator plates	24	
Diameter of commutator	2	"
Length of bearing surface of commutator	1 3/16	"
Total length of commutator	2¾	"
Width of brushes	1	"

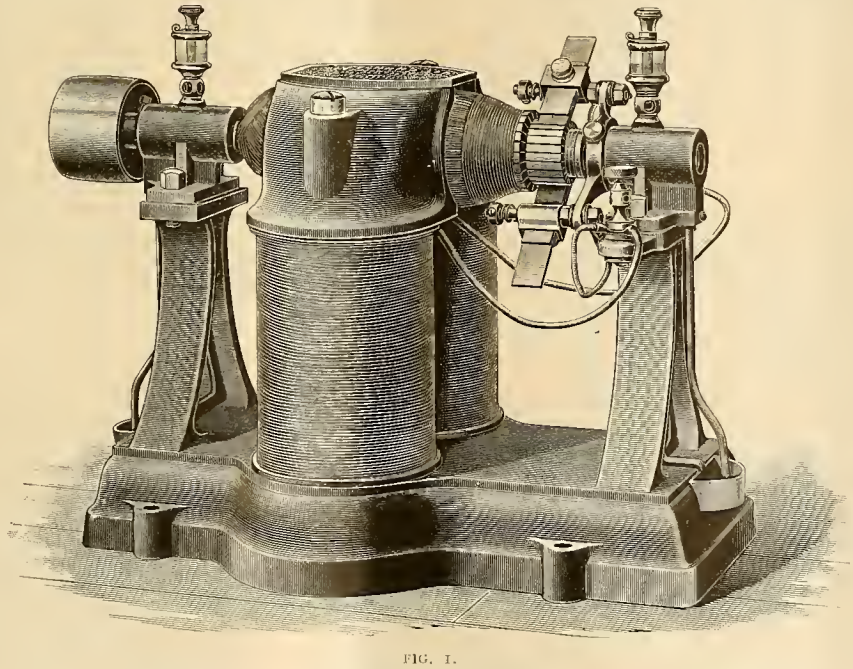


FIG. 1.

Slander by Telephone.

A Brussels paper of recent date has this: "An interesting question has just been raised in a Brussels police court. An impatient subscriber having remonstrated with the telephone operator the latter called in a 'big wig' of the management, who undertook to bring the importunate subscriber to reason. To his complaints, 'Mr. Big Wig' replied with abuse. The subscriber lodged a complaint, and the question was whether the abuse had been published. The plaintiff's lawyer maintained that so long as the company had not succeeded in suppressing the induction on its lines, abuse uttered by telephone must be held as public. In fact, all users of the telephone overhear distinctly entire conversations between other subscribers. The judge admitted the plaintiff's plea, and condemned 'Mr. Big Wig' to pay 10 francs fine, and 50 francs damages."

Topeka Electrical Road.

The Thomson-Houston company, through Theo. P. Bailey, manager of the railway department, has closed a contract for the installation of an electric road at Topeka, Kan. The road will be fourteen miles in length. Thirty electric cars will be equipped. The Thomson-Houston company will furnish everything with the exception of the road-bed and the station. The company which will operate the road is the Topeka Rapid Transit company. The contract price will be more than $200,000. The road will be one of the largest and best equipped in the country.

Westinghouse Leases the Consolidated and Sawyer-Man Companies.

The Westinghouse Electric company has leased the Consolidated Electric Light and Sawyer-Man companies, and will hereafter conduct the business of these corporations. The change will be gratifying to the stockholders of the companies as the stock, it is understood, will be placed on a dividend paying basis. The Westinghouse company has heretofore been a large stockholder in the Consolidated company, and under the new arrangement will have absolute control of the entire lamp trade under the Sawyer-Man patents. It will thus be enabled to extend its already large business in incandescent electric lighting. The Westinghouse Electric company has recently acquired certain improved processes for lamp manufacture, which it is claimed will enable it to offer to consumers a greater amount of light from a given expenditure of power than is guaranteed by any of its competitors. With its two factories, having a capacity of 7,500 lamps daily, it is in a position to offer to its customers a considerable reduction in the price of lamps.

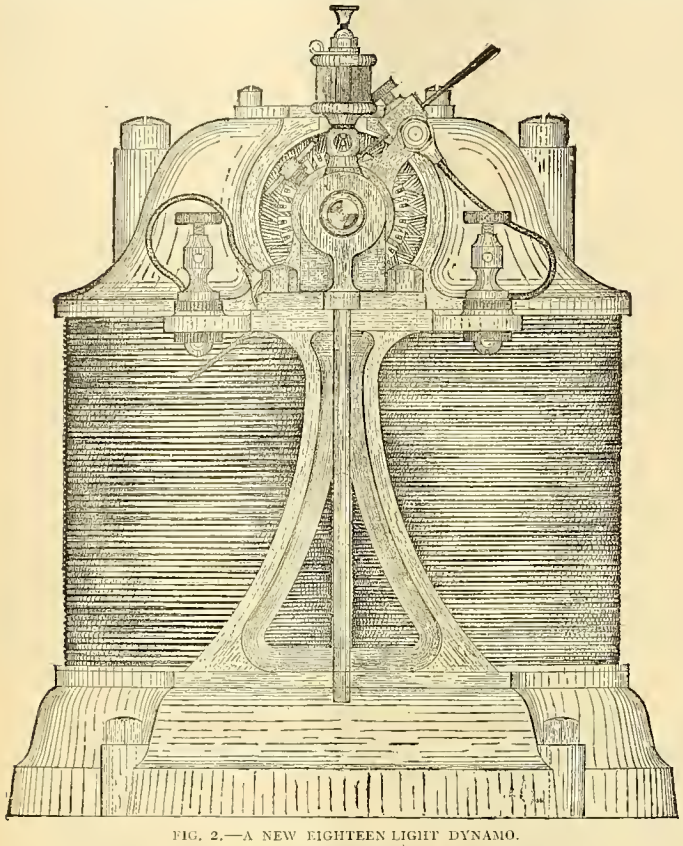


FIG. 2.—A NEW EIGHTEEN LIGHT DYNAMO.

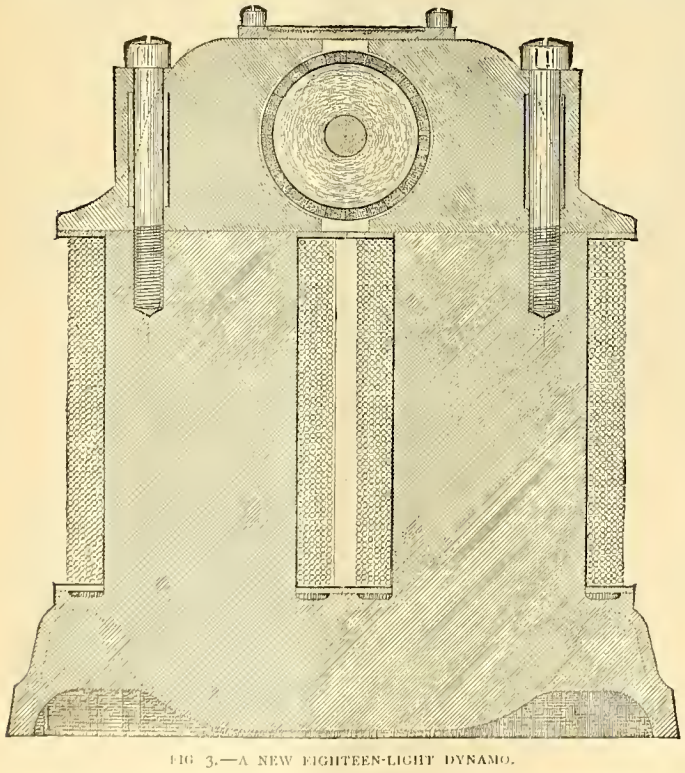


FIG 3.—A NEW EIGHTEEN-LIGHT DYNAMO.

The Torpedo Service.

Many persons suppose that if a war were to break out the entire American sea coast would be without defence, by reason of our having no men-of-war, says the New York *World*. But, as a matter of fact, we could destroy any hostile vessel in a twinkling of an eye; could simply annihilate her by pressing an electric button. That this is feasible may be seen any day, or any night either for that matter, at College Point, where the naval board of ordnance has been testing and inspecting an improved torpedo which contains its own motive power, can be run fast or slow, or in any direction, as desired by those in charge of it on shore, and can cut its way through the nets which are spread for it.

The messenger of destruction goes hissing through the water like the famed Stiletto, at twenty-four miles an hour; the officer in charge directing his assistant as to whether it is required that it be directed to port or to starboard, or reversed and called back. By swerving an electric switch to the right or to the left the vessel is guided, the operator following with his glass its movements.

This "destroying angel" consists of two cigar-shaped vessels, one of which is simply a float about three feet above the other, to which it is connected by four sharp stanchions; the lower one projects beyond the float at the bow, and at its stem is a propellor, above which is the rudder. From the stern there trails an electric wire, which connects with a keyboard on shore, or wherever the torpedo station is. Fore and aft on the upper vessel or hull, which is the only one which is seen at all above the water, are two flags, which serve as sights by which to guide it. The upper cigar is 18 inches in diameter and 44 feet long; the lower one is 24 inches in diameter and 40 feet in length, this latter being charged in the head with about 300 to 400 pounds of high explosive, which is fired either by the percussion of the cylinder against the side of the vessel or by an electric current from the shore, as desired. The lower hull also contains the engines, which are of the six-cylinder type, and the supply of compressed carbonic acid gas with which they run; also a device by which the gas is heated. The heating of the gas is accomplished by coils of copper pipes incased in cylinders containing sulphuric acid, and having lime chambers at each end. The sulphuric acid and the lime may be brought in contact by electricity when desired, and will in less than a minute heat the gas up to 600 degrees Fah., and keep it hot from one to three hours. The engines, each of which takes

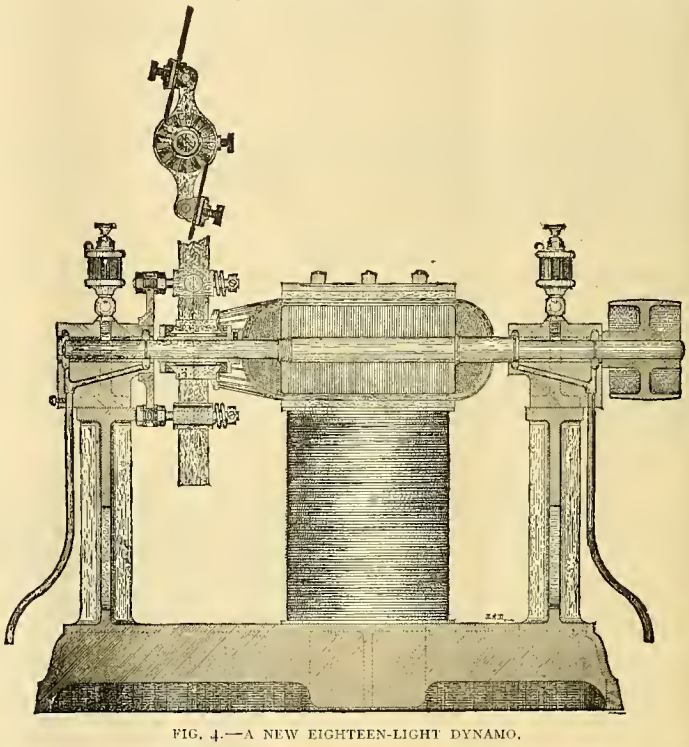


FIG. 4.—A NEW EIGHTEEN-LIGHT DYNAMO.

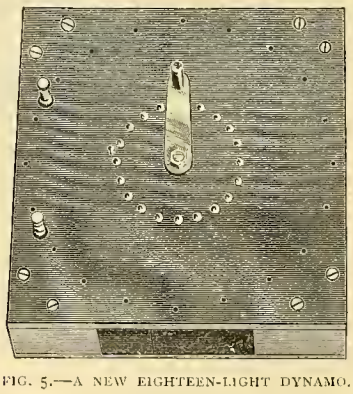


FIG. 5.—A NEW EIGHTEEN-LIGHT DYNAMO.

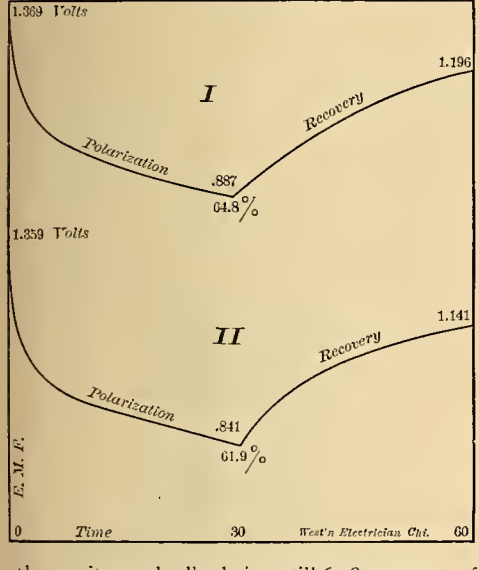
up only 15 by 24 inches of space, can run 800 turns per minute, at which speed each will develop 75 horse power, a wonderful capacity for a 524-pound engine.

The torpedo cuts through rope netting of inch hemp rope and strikes the target fair and square, exploding at once, as has been repeatedly shown. Of course, if a vessel is struck and the torpedo explodes, there is nothing left of either the ship or the torpedo; but if for any reason the latter be recalled, it can be sent out again at any time.

Polarization of Batteries.

By Prof. H. S. Carhart.

Mr. Rudd's paper on "Galvanic Batteries" in the Western Electrician of October 6th leads me to look over some of my notes on the same subject. The results obtained with a diamond battery two years ago make a better showing, I think, than either of the cells tested by Mr. Rudd. A fresh cell, which had never been on closed circuit, was compared with a standard Clark by the condenser method and found to have an e. m. f. of 1.369 volts. The circuit was then closed through a resistance of 5 ohms, and the e. m. f. was measured every three minutes for half an hour. The circuit was then opened, and the measurements were continued for forty-five minutes longer at the same intervals. The curve, Fig. *I*, exhibits the results. It will be observed that the e. m. f. at first fell rather rapidly but



then quite gradually, being still 64.8 per cent. of the maximum at the end of the first half hour. The recovery again was most rapid, immediately after opening the circuit.

Three days later the same cell, which had rested in the meantime, was tested again. The e. m. f. had risen to 1.359 volts, or within less than 1 per cent. of the original value. The process was the same as during the first test except that the recovery curve was traced for a half hour only. Fig. *II* exhibits the results. The loss by polarization this time was 38.1 per cent. instead of 35.2 per cent. as in the first case. It is worthy of note, however, that the internal resistance on beginning the first test was 0.725 ohm; while at the beginning of the second test it was 0.617 ohm. Thus the total resistance in circuit was smaller in the second test than in the former, and the polarization was accordingly more rapid.

During the past year, while conducting an investigation upon standard cells, I have observed the distinct polarization of cells of various types, including the Daniell and the Leclanche, when closed on an external resistance of 10,000 ohms. The amount of the polarization I did not determine, but it proceeded with sufficient rapidity to overturn a balance of e. m. f. s in two or three seconds. I have observed also that the e. m. f. of such cells changes materially upon disturbing the liquids, or shaking the zinc. When the method of comparing e. m. f.s is at all sensitive, therefore, much care must be taken in manipulating the cells so as to avoid the effects of mechanical disturbance.

Musical Electric Bells.

There are electric bells and electric bells, designed for every purpose that can be imagined, yet Shaw & Geary of Philadelphia, have found a novel use for a new bell they have recently placed on the market. This bell is of superior material and workmanship throughout, and is not intended to compete with cheap bells with which the market is abundantly supplied, consequently from the nature of its construction it can be devoted to another purpose, that is a musical purpose. The gongs in any event are of unusually fine quality, and when desired can be furnished accurately tuned to the chord of E, corresponding to the musical notes G sharp, B and E and the octave; or they can be furnished as a chime of four or six bells, or in two octaves, commencing at middle C, and including half notes, making a set of 25 bells. The gongs can also be furnished in a number of different shapes which bear such names as Opera, Mikado, Dome, Fancy, Garland, Sleigh, Rectangular and Swiss. But as inferred in the foregoing, these bells are designed primarily to meet a want for a thoroughly first-class bell of artistic design.

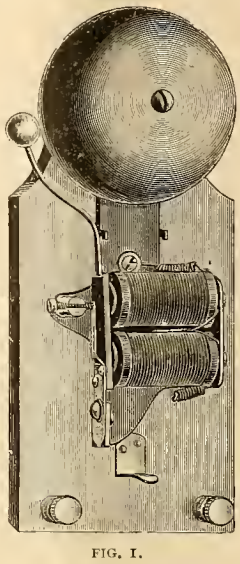


FIG. 1.

Figs. 1 and 2 show respectively the interior and exterior of the firm's new Norway iron frame electric bell. The frame, magnet cores and armature are made of Norway iron, which is soft and possesses admirable qualities, instead of cast iron. The firm argues for this construction as follows: Electric bells should be so constructed

FIG. 2.

that while the battery current is passing through the magnets, the armature carrying the striker for the gong should receive its full power, and when the contact is broken and the current ceases to flow, no trace of magnetism should remain. Cast iron, for the frame or case, having a hard surface, will slowly absorb the battery current and in a short time become magnetized, which retards the movement of the armature, and the addition of battery only remedies the defect. Consequently, as stated, the frame, magnet cores and armature of these bells are made of the best and softest iron, which will not readily magnetize. The magnet spools are wound with the best insulated copper wire to a resistance of 3¼ ohms and possess unusual attracting and repelling force. The gongs, binding posts, striker and armature are nickel-plated, which adds greatly to their appearance and prevents rust or corrosion.

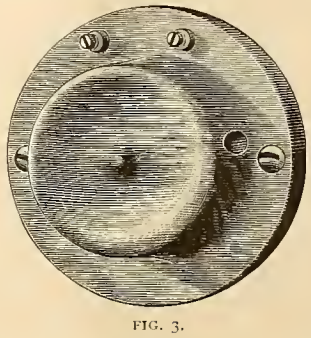


FIG. 3.

Pure platinum wire is driven into the adjusting screw and sheet platinum is riveted to the German silver armature spring, making a contact which will not corrode or drop off.

The bell may be readily adjusted for any amount of battery strength by slightly bending, with a pair of pliers, the lug carrying the armature.

The wood cases are made of seasoned, polished walnut, ash or cherry; the cap covering the movement being held in its place by an improved clasp.

The same firm also makes a buzzer which in quality of workmanship equals the bells. Fig. 3 shows the style. The buzzer has an adjusting screw on the side. The cases are turned from seasoned rosewood, mahogany, walnut, ash and cherry, are highly polished, and have nickel-plated binding posts and screws for fastening to the wall.

The Book Table.

Dynamo Electric Machinery. By Silvanus P. Thompson. Third edition; 672 pp.; published by E. & F. N. Spon, 35 Murray street, New York. Price $5.

A highly valued old friend comes to us in this third edition, and the welcome extended is greatly enhanced when a casual peep is taken at the contents. The former editions of this book have been justly regarded as standard, and we need add nothing to the encomiums which have been bestowed upon them. The preface so well covers the new features of the third edition that we feel constrained to quote it almost in its entirety:

"Most of this treatise has been rewritten for this edition, and much new matter has been added. In order to render the work more complete, some historical notes and a brief account of the system of electric units have been added to the introductory chapter. In that part of the book which is descriptive, the machines for furnishing continuous currents have been considered separately from those for furnishing alternate currents. The mathematical parts of the work have been entirely rewritten and curtailed.

"The algebraic and graphic methods of treating the various problems connected with dynamo-electric machinery were in the former editions kept apart; in this edition they are now combined. Some additional data useful in electro-metallurgy have been inserted in chapter XIII. A chapter has been added upon transformers for distributing alternating and continuous currents. The most important change, however, is the introduction (hinted at in the preface to the first edition of this work) of the conception of the magnetic circuit into the theoretical arguments. This conception, which during the last four years has revolutionized the practice of dynamo design, is developed in chapter XIV., and is made the basis of the theoretical treatment which follows. The essential part of the investigations of Rowland, Hopkinson and Kapp in this direction is embodied in this chapter. The author has also followed Kapp in the method of reckoning armature quantities by counting the number of conductors at the periphery, instead of the number of convolu-

tions, so as to make the formulæ applicable equally to ring armatures and to drum armatures. An important error in the treatment of constant current motors has been rectified.

"To the appendices have been added an abstract of the theoretical researches of Clausius, an account of some recent investigations respecting certain points in dynamo designs, an inquiry into the conditions of self-excitation, and some references to the use of the dynamo in telegraphy."

MANAGEMENT OF ACCUMULATORS; a Practical Handbook, by Sir David Salomons. Fourth edition. New York publisher, D. Van Nostrand; Chicago representatives, A. C. McClurg & Co. 176 pp.; size of type page 5½ x 3½ inches; bound in cloth, price $1.20.

This is one of the very few practical works on accumulators, and from its very nature would find a place in the library of every electrician who wishes to keep up with the times. But aside from this fact, the book is written by a man who has used accumulators extensively, and is in position to speak authoritatively of their management.

The fourth edition shows an entire revision of previous editions, and includes a few additional illustrations and some new matter.

ELECTRICAL INSTRUMENT MAKING FOR AMATEURS, a Practical Hand book. by S. R. Bottone. Second edition. New York publisher, D. Van Nostrand; Chicago representatives, A. C. McClurg & Co. 183 pp.; size of type page 5½ x 3½ inches; bound in cloth; price $1.20.

This is still another book familiar to electrical readers, who have made such a demand on the publishers that a new edition has been necessitated.

To the matter that appeared in the first edition an extensive chapter on the telephone has been added, making the whole very complete.

A Cottage Annunciator.

The Standard Electrical works of Cincinnati have introduced to the trade the style of annunciator represented by Fig. 1 of the accompanying illustrations, and have given it the name of

FIG. 1.

"cottage" annunciator. As might be inferred from both illustration and name this annunciator is designed for use in small houses or cottages in which there are but few points to which a servant may be summoned by an electric bell. There are but four drops in the annunciator.

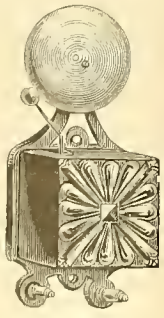


FIG. 2.

The woodwork of the instrument is handsomely designed, and as handsomely finished. The principal feature of the construction of the annunciator lies in a single pole piece, and the winding being done horizontally instead of vertically, which has been the practice heretofore. The annunciator is compact, and as there are no springs about it to get out of order, it is very durable. The instrument as a whole is very tasteful, and fills the want that has been felt for a small yet neat annunciator for small houses. The same company has recently placed on the market a new style of electric bell, shown by the accompanying cuts, Fig. 2 representing the

FIG. 3.

bell with its iron box cover in position, and Fig. 3, the interior. The framework of this bell is of steel, but the principal feature consists of a single magnet spool which requires a small space instead of the more common double spool.

Bell Hangers' Hand-Book.[1]

BY F. B. BADT.

PART II.

TWO-FLUID BATTERIES—(Continued).

CHAPTER XV.

The Leclanche Battery.

In this cell the exciting liquid is a solution of sal-ammoniac. In this the zinc dissolves, while ammonia gas and hydrogen are liberated at the carbon pole.

To prevent polarization in the disque form, Fig. 10, the carbon plate is packed inside a porous cell with fragments of carbon and powdered binoxide of manganese, which slowly yields oxygen, and destroys the hydrogen bubbles.

FIG. 10.—LECLANCHE DISQUE BATTERY.

In the prism form, Fig. 11, the binoxide of manganese is applied in plaques or prisms, thus avoiding the necessity of using a porous cell.

The Leclanche cell will give a continuous current only for a short time, the power falling off, owing to the accumulation of hydrogen bubbles; if the circuit is left open for a time the cell recovers itself, the binoxide gradually destroying the polarization.

The cell is in other respects perfectly constant, very clean, and as it does not require renewing for months or years, it is well adapted for working electric bells, annunciators, burglar alarms, and for domestic purposes. These batteries are set up in the following manner:

FIG. 11.—LECLANCHE PRISM BATTERY.

The Disque Form.—Put six ounces of sal-ammoniac into the glass jar, fill one-third full of water, and stir. Put in the porous cell and fill with water to the neck of the jar, pouring a little water into the hole in the porous cup. Put in the zinc and connect the battery.

The inside of the rim of the jar is paraffined, and should be kept greased to keep the salts from creeping.

The battery should be kept in a dry place of medium temperature. It requires very little attention; water should be poured in occasionally to supply the loss by evaporation. In case the solution becomes milky, and the battery fails to work, the solution, should be thrown out and fresh sal-ammoniac and water put in. If this does no good, soak the porous cell in warm water. If it still fails, new porous cells must be used.

The Prism Form.—In this cell the porous cup is dispensed with, and in its place is substituted a pair of compressed prisms or plaques, which are simply attached to the carbons by means of two rubber bands. The prisms contain all of the materials heretofore employed in the porous cup, combined with others not before used, compressed into compact and convenient form by powerful hydraulic machinery.

When the elements have become exhausted from long service the prisms should be taken off, new prisms should be attached, and the battery set up as before, with new zinc and fresh sal-ammoniac.

Only pure sal-ammoniac and well amalgamated zinc rods should be used.

CHAPTER XVI.

The Diamond Carbon Battery.

This cell, Fig. 12, is similar in action to the Leclanche cell. Instead of using binoxide of manganese to reduce

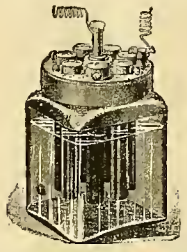


FIG. 12.—DIAMOND CARBON BATTERY.

polarization the surface of the carbon electrode is greatly increased, and the zinc electrode kept very small. Care must be taken to slip the small rubber ring over the lower part of the zinc rod to prevent contact between zinc and carbon. The cell is set up in the same manner as the Leclanche cell.

The inside of the rim of the jar is paraffined to prevent creeping of salts, and the cover fits very tightly to reduce evaporation.

CHAPTER XVII.

Gravity Batteries.

Gravity batteries belong to the class of two-fluid cells.

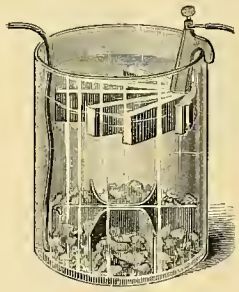


FIG. 13.—GRAVITY BATTERY.

Figs. 13 and 14 show two different styles, which are recognized as the leading representatives of the gravity type. Instead of employing a porous cell to keep the two liquids separate, it is possible, where one of the liquids is heavier than the other, to keep the latter on the bottom, and have the lighter floating upon it; this separation, however, is

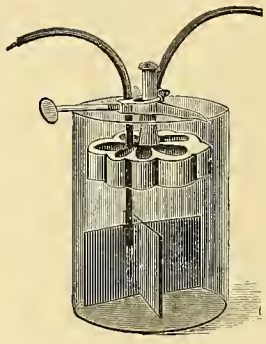


FIG. 14.—GRAVITY BATTERY WITH ADJUSTABLE HANGER.

never perfect, the heavy liquid slowly diffusing upward. These batteries are set up as follows:

Unfold the copper strip and place it in the bottom of the jar. Suspend the zinc about four inches above the copper. Pour clean water into the jar so as to cover the zinc. Then drop in blue vitriol in small lumps, not over six or eight ounces per cup at one time.

The resistance may be reduced and the battery be made immediately available by drawing about half a pint of solution of sulphate of zinc from a battery already in use, and pouring it into the jar; or, when this cannot be done, by putting into the liquid four or five ounces of pulverized sulphate of zinc.

[1] BELL HANGERS' HAND-BOOK, by F. B. Badt; in course of preparation; about 100 pages, 80 illustrations; flexible cloth binding; type page 6 inches by 3 inches; price $1. All rights reserved.

Blue vitriol should be dropped into the jar as it is consumed, care being taken that it goes to the bottom. The need of blue vitriol is shown by the fading of the blue color, which should be kept as high as the top of the copper, but should never reach the zinc.

After the battery has been started no further attention is required, except to keep it supplied with blue vitriol, until the quantity of sulphate of zinc in solution has become too great. In that case draw out a portion of the top of the liquid with a syringe or a cup, and replace it with clear water.

As long as the battery continues in action there is an increase of the quantity of sulphate of zinc in solution in the upper part of the jar.

A hydrometer is convenient for the purpose of testing the strength of this solution. When the specific gravity is less than 15 degrees, there is too little sulphate of zinc; when it is 35 degrees or over, there is too much in solution, and it must be diluted.

When the zincs become coated so as to interfere with the action of the battery they must be taken out and scraped clean and washed.

Chapter XVIII.

Dry Batteries.

Very often it is necessary to arrange batteries so that they may stand considerable jarring, or even overturning. A liquid, of course, would be spilled. Dry cells, for instance, are needed in railroad cars for the electric bells, in military telegraphy, and in portable testing sets.

One of the early batteries of this type is Sir Wm. Thomson's sawdust battery, which is, in fact, a Daniell cell filled with sawdust.

FIG. 15.—DRY BATTERY.

Gassner's battery, Fig. 15, is considered one of the best dry batteries, and is extensively used in places where a cell containing a fluid would be objectionable. This element is mounted in a strong zinc case. The top of the battery is hermetically closed, and, consequently, no crystallization of salts takes place at the surface. Batteries are furnished ready for use, and will work well until completely exhausted. They can be used with great advantage in places subject to high or low temperature. When at rest no chemical action takes place; the component parts of the battery are consequently not consumed. These desirable properties of the dry battery are due in the first place to the peculiar porous substance contained in the battery in place of the solutions which, although it forms a compact or nearly solid mass, allows the gases to pass. The porous mass forms no deposit on the zinc which would tend to increase the internal resistance, and consequently, weaken the current. The necessary moisture is contained in the battery in chemical combination, and not in form of a free liquid.

Chapter XIX.

Classification of Batteries.

Batteries may be classified, according to their use, into open circuit and closed circuit batteries.

Open Circuit Batteries.—These batteries are used where a current is needed for a few seconds at a time only. If the circuit is kept closed for any length of time, these batteries will become rapidly polarized, and the current will be so weak as to be unable to do the work. When the circuit is opened the battery will recover itself in time. These batteries are applicable to bells, alarms, telephones, gas-lighters, etc. To this class belong the Leclanche, diamond carbon, Gassner and Smee.

Closed Circuit Batteries.—These are used for continuous work, as, for instance, electro plating, charging accumulators, electric lighting, etc., or when a current is required to flow continuously through a wire, and an apparatus so arranged as to signal the break of this wire, as in certain safe-protecting devices or police call boxes. This class of batteries may be subdivided into:

A. Batteries with a constant current, able to do considerable work, such as electro plating, electric lighting, running motors, etc., for hours at a time.

B. Batteries with a constant current, able to do very little work, such as in safe-protecting devices, several medical appliances and alarms, but able to do this continuously for months without any attention.

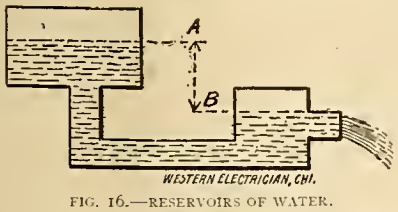


FIG. 16.—RESERVOIRS OF WATER.

To class *A* belong Grenet, Grove, Bunsen, carbon, nickel-plating and Fuller.

To class *B* belong Daniell and gravity.

ELEMENTARY DATA.

Chapter XX.

The Electric Current.

The reader has now learned how the electric current is practically generated in voltaic or galvanic cells or batteries.

In order to understand the action of what is called the electric current, we will consider two reservoirs of water connected by a pipe, Fig. 16. The electric current may be likened to the flow of water through this pipe from the higher to the lower level.

The unit of current strength, also called the rate of flow, or intensity, is the ampere. In the illustration we would say the water is flowing through the pipe at the rate of one gallon per second. In speaking of the electric current we would say it has a strength of, say, one ampere.

The unit of electromotive force, also called electrical pressure, or tension, or difference of potential, is the volt. In the illustration the head of water, or the difference between the levels, *A* and *B*, is similar to the electromotive force.

The unit of resistance is the ohm. Resistance may be compared with the friction of the internal surface of the pipe offered to the water. It follows that the more cross-section the less friction, and the less cross-section the more friction, for the same volume of water flowing through the pipe in a given time.

In the following only the terms, current strength, electromotive force—frequently written e.m.f.—and resistance will be used.

Chapter XXI.

Ohm's Law.

Ohm's law expresses the relation of current strength, electromotive force and resistance to each other. It says: Current strength equals electromotive force divided by resistance. We can write this $C = \frac{E}{R}$, C standing for current strength, E for electromotive force, and R for resistance.

Chapter XXII.

Conductors and Insulators.

Bodies in which the current moves freely are called conductors, and those in which it does not move freely are called insulators. Examples of conductors: Metals, solutions of chemical salts, moist earth, etc. Examples of insulators: Porcelain, rubber, gutta-percha, sealing wax, dry wood, etc.

Chapter XXIII.

Direction of the Current.

For convenience sake we assumed that the electric current flows from the positive pole of a galvanic cell through the external circuit back to the negative pole. In order to find the direction in which the current is passing through the wire, we place a pocket compass, Fig. 17, under the wire, Fig. 18. The north-seeking pole of the needle, called the north pole, and distinguished either by a different color—blue, for instance—or by a little brass rivet, will be deflected to the left when the current flows in the direction of the arrow, Fig. 18. Or, in other words, the positive electricity enters at *A* and leaves at *B*.

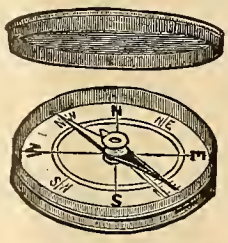


FIG. 17.—POCKET COMPASS.

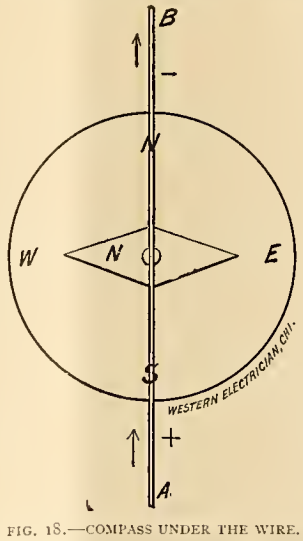


FIG. 18.—COMPASS UNDER THE WIRE.

When the compass is held above the wire the north pole of the needle will be deflected to the right.

General rule: Imagine yourself swimming in the current, always facing the needle. The positive current entering at your feet will cause the needle to deflect to your left.

Another general rule: Think of the word Snow. With the wire over the compass the current flowing from the South to the North will deflect the needle to the West; in other words, from S-outh to N-orth O-ver W-est.

The compass should be tested before these trials are made, as the polarity may have been reversed by the proximity of dynamo electric machines or other powerful magnets.

(To be Continued.)

New England Electric Exchange.

The quarterly meeting of the New England Electric exchange was held in Boston, October 8th. The report of Henry B. Cram showed among other things that 104 applicants had paid license fees since July 9th. P. H. Alexander in his address spoke in the following terms of the progress of the organization: "Not only has the membership of this body increased since the last meeting from 54 to 80 members, but great interest has been shown by the men who have applied for licenses. Up to this date 128 men have applied for licenses; men who have felt before this exchange existed that there was no standard by which they could gauge their knowledge, while the examinations have shown them, in many cases, wherein their learning was deficient, but ambitious, as young men generally are in their business, they set forth to qualify themselves for the examinations, and gain the higher prize. Perhaps right here it would not be out of place to give a little statistical material regarding these applications. We have had, as I said before, 128 applications for licenses. One of the applicants died before his examination; of the others, 80 were examined, and licenses were granted to 77; 49 received the grade applied for; 3 received a higher grade than applied for; 33 received a lower grade; 3 were rejected as unable to obtain even the lower classes of license." Considerable discussion followed in reference to changes in the classification of licenses. The wording for the third class license was modified so as to read: "Third class licenses shall be issued only to persons fully competent to do electric light and power wiring, and who are incompetent to operate electrical machinery."

Copenhagen Electric Light Regulations.

The municipal authorities of Copenhagen, Denmark, have issued these regulations in relation to electric lighting: "The dynamos must be placed in a spot remote from combustibles, and must, when at work, always be tended by a man. The electrical tension must in no case exceed 200 volts, and alternating currents are only by special permission. All wires must be entirely isolated, and in the streets incased in iron tubes. Wires must not be concealed in buildings in the plaster of Paris or stucco in ceilings, while looping must be avoided as much as possible. At every house a switch must be fitted in an easily accessible place for the use of the police or firemen in case of fire. Wires of arc lamps must not run closer to each other than four inches, and in the case of glow lamps two inches. In the conductors in buildings a connecting or safety wire of some metal easily melted must be inserted, so that the current is interrupted when reaching double the strength of the force allowed, and these connecting links must be entirely isolated. All arc lamps must be fitted with a guard for preventing the fall of chips of carbon outside them. Arc lamps must on no account be used in factories where combustible or explosive articles are manufactured, but glow lamps may be used if fully protected by glass globes. The diameter of the wires shall be 1 square mm. where the current is under 50 amperes, and 2.5 mm. when above 50 but less than 100 amperes The fire brigade and the municipal electrical engineers shall at all times have access to the electric plant."

Type Justifying Machine.

A New York dispatch says: The working model of a machine for justifying type composition automatically was on exhibition yesterday at 22 Spruce street. It is the invention of Risley & Lake. The model weighs about six hundred pounds, and was driven by an electric motor. The inventor's alphabet is cut on a cylindrical metallic shell. The mechanism is operated by a system of keys similar to that employed in ordinary type-writing machines, the highest speed attained being about twenty words per minute. The printing does not begin until the operator has touched the keys for about fifty letters. A character is inked immediately before its impression, The newest feature about the invention, that of spacing-out or shortening a line, is wonderfully accurate. Work by the machine has been reproduced in the ordinary lithographic way. The invention has been tested on matrices and some very fair plates were obtained.

The Krebs Telephone.

M. Krebs has recently designed a form of telephone, the magnetic circuit of which is closed, save for the small air space between the core and the diaphragm, and at the same time is of constant magnetic resistance, says an exchange. Both the core and diaphragm are of soft iron, the magnetic field being produced by one or more magnets, which on the one hand have magnetic connection with the diaphragm, and on the other with the core carrying the bobbin. The diaphragm is of somewhat curious construction, not being of uniform thickness, but designed so that in no part of its section is the iron saturated. By this arrangement the variations in the magnetic field due to the vibrations of the plate are much intensified, with a corresponding increase in the efficiency of the telephone.

The Pumpelly Storage Battery & Motor company has been organized at Chicago. The capital stock is $300,000. The manufacturers are James K. Pumpelly, Louis Mendelsohn and Abner Crossman.

Western Electrician.

EVERY SATURDAY.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

PAGE.

A New Eighteen-Light Dynamo, Illustrated 203, 204
Slander by Telephone 203
Topeka Electrical Road 203
Westinghouse Leases the Consolidated and Sawyer-Man Companies 204
The Torpedo Service 204, 205
Polarization of Batteries, by Prof. H. S. Carhart, Illustrated 205
Musical Electric Bells, Illustrated 205
The Book Table 205, 206
A Cottage Annunciator, Illustrated 206
Bell Hangers' Hand-Book, by F. B. Badt, Illustrated, Part II.:
Two-fluid Batteries, Continued 206, 207
Elementary Data 207
Copenhagen Electric Light Regulations 207
Type Justifying Machine 207
The Krebs Telephone 207
Editorial 208
The Solution of the Municipal Rapid Transit Problem, by Frank J. Sprague, Discussion, Part IV.:
Some objections to the Overhead Conductor for Electric Railways, by M. B. Leonard 209
Note on Gearing for Electric Railway Motors, by Almon Robinson 209, 210
Elias E. Ries' Remarks 210
Cincinnati Electrical Society
President Foote's Address 210, 211
Dr. Otto A. Moses' Address 211, 212, 213

DEPARTMENTS.

Correspondence 213
The Electric Light 213
The Electric Motor 214
The Telegraph 214
Electrical Patents 214

THE Chicago city council at the meeting last Monday night adopted the Ernst Telephone ordinance. This measure provides that the rental for instruments in Chicago shall be $95 the first year and $85 each subsequent year, or $75 per year on three years' contracts. The ordinance is decidedly unfavorable to the Chicago Telephone company, as the regular rate now charged by the corporation is $125 per year. In addition to the provision concerning rentals, the measure requires that a telephone shall be placed in the mayor's office, department of public works, fire department, police department, building department, city collector's office, city clerk's office, health department, and law department. It is also provided that a company shall rent to the city of Chicago telephones for the sole use of the police and fire alarm systems at an annual rental of not to exceed $5 per annum for each telephone outfit. The provision is also made that all lines except those going through the tunnels, within the following boundaries, commencing at the intersection of the lake and North avenue, thence west on North avenue to Wells street, south on Wells street to Lake street, west on Lake street to Ashland avenue, south on Ashland avenue to Sixteenth street, east on Sixteenth street to Butterfield street, south on Butterfield street to Thirty-first street, east on Thirty-first street to the lake, shall be placed in underground conduits, which shall be built at the rate of two miles per annum from the passage of the ordinance, and shall be constructed under the supervision of the commissioner of public works. Mayor Roche intimated that he thought the ordinance was illegal.

THE American Institute of Electrical Engineers, at the first fall meeting, resumed the consideration of the municipal rapid transit problem. The session was devoted to the discussion of Frank J. Sprague's paper. M. B. Leonard and Almon Robinson presented papers on branches of the subject. We reproduce these, and also Mr. Ries' remarks, in this issue. The remainder of this discussion will be published in subsequent numbers. Mr. Leonard enumerates some of the defects which he considers inherent in the overhead system. It is not an ideal method of operation, he asserts, but he considers it a pioneer in the comparatively new field of electrical street car propulsion. Mr. Leonard, in closing his paper, expressed his preference for the storage battery system. Mr. Robinson's paper on gearing for electric railway motors was read by the secretary, and Mr. Ries followed with an address, which elicited well-merited applause.

THE London *Electrical Review* discusses at considerable length the subject of electrical progress in the old and new worlds. The theme was suggested by the papers read by Prof. Ayrton and Prof. Forbes before the British association, but the *Review* adds: "At all times and in all seasons when electrical progress is the theme, we find the American lauded, while we poor Britishers suffer, of course, by a comparison which sometimes we may be tempted to regard as odious." The authors of the two papers praised American industrial skill and compared American enterprise with British ultra conservatism. The *Review*, in coming to the defence of British talent, says that in America the old proverb, "Necessity is the mother of invention," has been reversed, and becomes, "Invention is the mother of necessity." The meaning is explained in this way: "If we invent to satisfy a want which has already become manifest, we do well, but if we invent something which develops a want, whose existence is scarcely suspected, we do better. The Americans seem to us to follow out the latter course." The *Review* takes issue with Prof. Forbes' statement that the development of electrical industry in America is due to technical education among the moneyed classes. There is money always forthcoming in England, the paper adds, when the capitalist sees a fair chance for a return for it; it is the market for electricity which is wanting, and, "in the deeply rooted antagonism of the Britisher to change of any sort, lies the real hindrance to progress with us." America is new, says the *Review*, and as a consequence change is easy and rapid, but in England every departure must be considered in its effect on each of its complex interests. Technical education, the paper continues, is powerless to effect a change in this particular. If education of any kind were desirable, it would be of a kind to teach the British public to appreciate and employ the new illuminant. The *Review* continues: "In all the new towns in America they have the electric light. These towns discovered a want, and it may be that in places where money was made easily the inhabitants, heedless of the cost, were often moved by the feelings which in early days prompted the Australian miners to light their pipes with bank notes; but to us that matters not. Whether their wants were due to a craving for something new we do not stay to inquire; the point is that a general want existed, and we in Britain have only just succeeded in creating a similar want. Whether the public were induced to reject electric illumination because it could not compete with gas, is outside the question. The only fact we are aware of is that on the terms on which it was offered generally it was not wanted, and hence its progress has been limited." In further explanation of the marked progress of American industry the *Review* says that American business men are smarter than those of England, and makes this singular comment: "American smartness is not the kind of thing which we should like to brag about, and for real honest work we are accustomed to think we are not behindhand." If the remark were not so utterly senseless, it might be worth while by the aid of a few comparisons, to indicate its falsity. The English are behind in "honest work," as every English electrician of note has admitted and bemoaned. Their only claim is that they are not behindhand in honest theory. But the *Review's* position is utterly inconsistent. It speaks of "American smartness" as the cause of the greater progress of industry on this side of the water, then proceeds to condemn the "smartness," and finally denies the honest progress which it has assumed and explained. The *Review's* position might have been stated more clearly in this way: "We are behind the Americans. While they have been accomplishing wonders, we conservative Englishmen have been engaged in sweet scientific contemplation, but, thank heaven, we are not smart. That charge cannot be laid at our doors. We have decided also to withdraw the admission that Americans are ahead of us." Such comments are inspired by consuming jealousy and crabbed narrowness. What is American smartness anyhow? Are American business men a whit less honorable than those of England? We think not. With the following explanation with which the article closes we have much more sympathy: "We have not the same facilities for making a market, and the area of our efforts is necessarily limited. To compare the lighting to be done in America with the lighting to be done in Great Britain, is a manifest absurdity. If every electrical factory in our land were at once increased to ten times its present size the possible production would be then but a small fraction of the production in American factories. Though production is cheapened by working on a large scale, let us bear in mind that American factories are the result of the demands of the American public for the electric light. Let us create a demand, and the factories to supply it will soon arise."

THE Cincinnati Electrical society is now to be numbered among the leading societies of its class in America. Organized but a few weeks ago, it numbered at its first public meeting, October 6th, seventy-five members, and inaugurated what we trust and believe will be a long, instructive and useful course, in a most thorough and happy manner. The addresses of Dr. Moses and Mr. Foote are given in the proceedings of the meeting. Both will amply repay perusal. Dr. Moses, always original, covered the ground of electrical education in his own way, which is only another form of expression for bright, interesting, witty and instructive. His address was well received, and was frequently greeted with hearty applause.

Mr. Foote's introductory remarks show here and there a vein of deep philosophy of which we did not suppose the gentleman possessed, but there is nothing at all uncomplimentary in this admission on our part, inasmuch as Mr. Foote's sphere is that of a plain practical business man. We can count Mr. Foote as a new discovery, and one of great possibilities in the electrical line.

The Cincinnati society is progressive. Unlike any other American society of the class, it has thrown open its doors to the ladies. They were present in full force at the first meeting, and no small number of them were busily engaged noting in memorandum books points made by the speakers. A few months ago we noted the fact that Mrs. Ayrton, wife of Professor Ayrton, whose name is known in connection with electrical instruments the world over, was teaching a class of ladies in London. Surely if English ladies find profit and interest in the study of electrical science, American ladies will not be found lagging behind. The Cincinnati ladies, to the best of our knowledge, are the first to be recognized in one of the distinctively electrical societies of prominence to-day. They will please accept our heartiest wishes that their success in this field may be as pronounced as that in other fields universally recognized as peculiarly feminine fields, and that they may receive the rewards due to conscientious thought and unremitting labor.

The Solution of the Municipal Rapid Transit Problem.[1]

By Frank J. Sprague.

PART IV.

A meeting of the American Institute of Electrical Engineers was held October 9th, in New York.

Mr. Phelps was elected chairman for the evening, and Secretary Pope stated the object of the meeting to be the discussion of the paper read by Frank J. Sprague before the institute on June 19th. He said: "On account of the length of the paper it was considered wise to defer the discussion until fall, and in considering the advisability of taking it up this evening the council decided that as we had a member in Richmond who was on the spot, and has taken great interest in the work to which Mr. Sprague referred, and is in an entirely independent and unbiased position, he would be able probably to give us some valuable information in regard to the work done. In addition to Mr. Leonard's contribution to the discussion. I have a note from Almon Robinson of Lewiston, Me., which will also be read, in regard to gearing."

Some Objections to the Overhead Conductor for Electric Railways.

BY M. B. LEONARD.

Of all the valuable papers read before the institute, probably none has excited greater interest than Mr. Sprague's admirable contribution on "Electric railways the solution of the municipal rapid transit problem," in which the advantages of electricity in practical operation have been so well set forth as to convince the most skeptical of its superiority over all other methods of traction for this class of traffic. Although the paper was written with special reference to the adaptability of electricity in solving the problem of rapid transit in the great city of New York, the benefits resulting from this system of propulsion may be obtained equally as well elsewhere, and prove to be as permanent as we have found them in our historic city of Richmond.

To electrical engineers this comparatively new application of the electric current is one of the most important questions that has come before them, and should be carefully studied in all its details so that the defects and objections may be pointed out and provided against, and the most perfect methods evolved as speedily and fully as possible. But in working this question out it must be remembered that "the more haste, the less speed," and that before undertaking to surpass the locomotive it is wiser to prove its superiority over the horse or mule. Having accomplished this successfully, then it is time to endeavor to rival steam. In attempting what has been aptly described as "feats of sensational engineering," it should always be borne in mind that failure inevitably deals a severe blow to the whole cause of electric traction, the general public not always being inclined to be discriminating in such cases, as will be remembered from the accident which occurred to a number of capitalists and prominent people some years ago, who were engaged in testing the traction system of a well known electrician

A second point of the utmost importance is the necessity for first-class workmanship. Anything worth doing at all is worth doing well, and particularly is this the case with the utilization of a new force. This is so self-evident as to require no further comment.

While it has been successfully demonstrated in the city of Richmond that electric traction is really the solution of the rapid transit problem, and we have felt in the increased value of real estate and the growth of our city in population and reputation the substantial benefits resulting therefrom, I have considered, from my daily observation of the operation of this electric road, that the overhead wire system cannot be made a perfect or ideal method of operation under all circumstances, because of the defects inherent in such a method. But that it will serve as a pioneer in the new field, and will be supplanted in time by a more perfect system, I have not the least doubt, and in the following remarks I will endeavor to show some of the objections that have come to my notice, although there may be others that have escaped my attention, owing to the extreme reticence of all parties connected with the enterprise, doubtless from business reasons.

Of the three most commonly used, the overhead system appears to be the favorite. The latest report of electric street railways in operation in America, showing that out of a total of forty-three not less than thirty-six are using the overhead system, and that at least thirty now under construction have arranged to do so. Doubtless the smaller cost, as compared with the other two, was an important factor in deciding so largely in favor of the overhead conductor.

As used in Richmond the details of operation have been shown so fully and clearly in Mr. Sprague's paper that it is unnecessary to repeat them here, beyond stating that the rail and earth system is adopted in connection with the overhead wire.

During the seven months of active operation of the Richmond Union Passenger railway many thousands have been successfully transported every day, and at a very much lower cost than could possibly have been done by horse power, owing to the excessive grades encountered; but the defects of the overhead system are now becoming more apparent as the plant suffers its material depreciation, and we are now in a better position to judge of its value as a permanent institution than we could possibly have done heretofore.

It is an undisputed fact that the encumbering of the streets with the poles required for the overhead system is one of the most serious objections to its use, although they are hid to a large extent in many places by the shade trees and foliage, yet on the main streets of our cities, where this system is most likely to be used, they are not only a grievous eyesore, but also increase the liability to accident from runaway horses and other causes. Their appearance would not perhaps be so offensive were it possible for them to maintain an erect position, but on account of the weight of the trolley wires and the pressure of the trolley the tops of the poles are constantly pulled together, notwithstanding they may have at first been raked in the other direction, and thus the unsightly effect is augmented.

Those of us who are acquainted with telegraph line construction can appreciate the great leverage exerted by a heavy strain on the top of a pole twenty-five or thirty feet high, unsupported by guys or otherwise, and will readily understand that it is only a question of time before the poles must be reset or replaced with heavier ones This has been especially the case on the curves where the strains have been greatest, in some instances approximating a pull of 650 pounds; nor does the network of wires, span, trolley, guard and curve inspire the public with any feeling of toleration for the disfiguring of its streets, but must hasten the time when the clamor for underground wires will compel their removal.

But to my mind the most serious objection is the employment of the bare trolley wire, carrying a current of 500 volts and about 90 amperes, which I consider not only dangerous to life on account of the frequent breakages of the wire, which on one occasion last spring in falling struck and killed a horse, but also in damage to property by fire. It is claimed that the use of guard wires will always prevent the possibilities of such an occurrence, but the guard wires did not obviate the burning and melting of the telephone wires when on one occasion the breaking of an exchange telephone pole threw them across the trolley wire, and it was necessary to shut down the railway to prevent the entire destruction of the exchange, and possibly the firing of the subscribers' instruments and houses.

That the trolley wire is liable to breakage at any time has been shown twice during the past week, to the interruption of travel and dissatisfaction of the public; while not so very long ago the wires over one of the curves were pulled down on top of the car by the trolley catching in it, and travel entirely suspended on that part of the line for one or two days.

A very serious defect in the use of the bare trolley wire is the difficulty of securing proper insulation. Thus far porcelain knobs seem to have been found best adapted for this purpose, and the leakage resulting, especially in damp or rainy weather, must be considerable on the whole length of the line, and must cause a large waste of current. This is probably the reason why it has been impracticable to run over about thirty cars at one time out of the forty with which the road is equipped, and would seem to indicate a very large loss of energy. In view of the fact that porcelain insulators have been long ago condemned for telegraph purposes, where a comparatively small current is used, it seems strange that they should have been adopted as the best means for securing insulation in circuits of such high potential as are employed on the Richmond road.

The trolley itself seems to be a clear source of trouble and difficulty to manage properly. As has been shown, it consists of a grooved wheel at the end of a counterbalanced pole, held by a spring against, and making contact with, the under side of the working conductor. In rounding curves it must be carefully watched by the car conductor to prevent it leaving the trolley wire and thus stopping the car, and at night extinguishing the lamps, which has proved exceedingly disagreeable to the passengers, while on busy days it has seemed necessary to put a third man on at each car, at additional expense, for the sole purpose of attending to the trolley. Sometimes the trolley pole has broken, or the springs holding it against the wire given way, stopping further progress of the car, or requiring a man to stand on the car roof holding the trolley pole against the wire until the repair sheds were reached.

One of the most unsatisfactory features about the arrangement of the Richmond road is the ground circuit, not only because of the difficulty of getting a good ground, which has in this case only been accomplished by connecting the track with the whole gas or waterworks system of the city, to the detriment of our exchange telephone system, so well described by the telephone superintendent, Mr. McCluer, in his paper before the recent telephone convention; but the fact that it is necessary to have a clean track to work on, otherwise vivid flashes of electricity will appear, to the terror of the horses in the vicinity and damage to the motor; or should it happen that there is a sufficient quantity of dirt on the rail, it will cause a higher resistance than the potential of the current can overcome, and of course stop the car. Should the motor man get off to push it over the dirt and fail, as sometimes happens, to switch off the current from the motor, the full current on the line will pass through it just as soon as a good contact is made, and the result is a burnt armature and a disabled car. This seems to have been particularly the case during the recent stormy weather, when I am informed that the number of available cars for traffic on the road was reduced to about ten. Possibly the saturation of the motor by the rain, and the effect of lightning on the trolley wire, had also something to do with the case. Owing to the reticence of the employes above referred to, it has been difficult to ascertain just what damage has been caused by lightning striking the trolley wires and injuring the motors; but that there has been serious trouble from this source, I have no doubt. The very best forms of lightning arresters have not proved sufficient to prevent injury to electric light dynamos where insulated wires are used on the outdoor circuits, while the bare wire used for the working conductors on overhead electric traction systems must always render them more susceptible to trouble from this direction.

After setting forth the difficulties which have been shown in the practical operation of the most extensive system of electric traction in the world, it gives me pleasure to direct attention to the remarkable behavior of the Sprague motors under all the conditions to which they have been subjected for the past seven months, which has been, indeed, remarkable. No load has been too heavy, and no grade too steep for them to ascend. Perhaps the severest test they ever received was on the night of July 4, in bringing the crowds from the new Reservoir park, when the ordinary open cars carried over 100 passengers, and the closed cars over seventy-five each; so many, in fact, that the axles of one or two of the cars broke down under the load, all of which must be exceedingly satisfactory to the inventor, and places the Sprague motor at the very head of the many excellent types or forms that have been devised at home and abroad.

The objections referred to apply equally as well to all forms of overhead systems, except where a second wire is used for a return instead of the track and earth, and also where the trolley pole is discarded for the movable trolley. But the increased number of aerial wires required, as well as the heavier fixtures needed to sustain them, render these systems just as objectionable.

We are very anxious to see the effect of ice, sleet and snow upon the operation of our road, as it has not yet passed through a winter in complete running order. A heavy sleet storm has often prostrated our telegraph lines, and I see no reason why the overhead electric railway wires would be exempted from similar troubles, nor why the covering of the rails by ice and snow will not render it difficult to make a sufficient contact to operate the line successfully, not to speak of the loss of current by leakage or escape from the trolley wire; but I have no doubt that the ingenuity of those who have overcome all the problems encountered in opening up with such success the Richmond Union Passenger railway will be sufficient to insure its continued operation in spite of wind and weather, and to no one more than myself will this be gratifying, since it was through my efforts that attention was first directed some three or more years ago to the splendid opportunities for electric traction that Richmond presented, although I am free to confess that my inclinations were toward the application of the storage battery, which obviates all the troubles and defects developed by the overhead systems, and against which no more serious objections seem to be brought than the extra weight caused by the batteries and the greater first cost, as compared with the aerial systems, all of which, it appears to me, are more than counterbalanced by the difficulties and annoyance in the systems just described.

The very satisfactory results obtained in the operation of the new electric storage cars on the Fourth avenue railroad in this city, as well as by Mr. Wharton, in Philadelphia, Mons. Huber, in Brussels, and elsewhere, prove, as I have believed, the storage battery to be the only ideally perfect system of electric traction for municipal purposes.

The Chairman: Gentlemen, if it is agreeable to you I will ask the secretary to read Mr. Robinson's paper. After the reading of the papers, the discussion will be open.

Secretary Pope read Mr. Robinson's discussion.

Note on Gearing for Electric Railway Motors.

BY ALMON ROBINSON.

Probably no one will be disposed to deny that in devising a connection for the motor and the car wheels, what Mr. Sprague attempted to do, has been done extremely well. Has he attempted all that is desirable?

Mr. Sprague's investigations have shown that in street car work a very large percentage of the whole power used is expended in starting the cars. It seems to me, that a motor whose speed has a fixed ratio to that of the car wheels must work uneconomically when the car is moving slowly, for no amount of skill spent in varying the magnetic circuit can prevent an armature from wasting a current sent through it when it is practically standing still. It would seem therefore that wide variations of speed and load would make it necessary at times to weaken the field to an unprofitable extent.

Perhaps, however, Mr. Sprague may be able to show that a properly designed motor will work with a high efficiency in doing anything which he puts upon it in railroading. But even in that case, there would still remain the extra cost and extra weight of a motor large enough to lift its heaviest load by a dead pull. To do the hardest part of his work, Mr. Sprague is really using a thing in which he disbelieves—a slow moving motor. In the storage car problem this matter of weight, and bulk and cost, becomes the most important element. Here, the present practice is simply the hauling about of ten men to do by main strength what one man could do by a lever. The desirability of a variable leverage for the motor has not escaped the attention of experimenters. In Mr. Henry's Kansas City work, an arrangement of toothed gearing and clutches was tried. I have never learned whether this particular feature proved a help or a hindrance; nor whether it is in use on the Henry road said to be running at San Diego, Cal. A prominent inventor has expended a good deal of ingenuity on the details of a plan making use of reciprocating friction pawls. Mr. Reckenzaun tried and abandoned a leather covered chain, clamped between two cones in such a way that the diameter of the circle of contact could be varied.

Mr. Van Depoele has suggested, and I presume, tried a connection having two different speed ratios; in which friction gears were used. For this particular purpose (furnishing a variable speed ratio) I am obliged to confess myself a believer in the possibilities of frictional gearing. For electric railroad work, it is certainly under a cloud at present. Those who have used it most, like it least. The eminent engineer, who, about a year ago, read a paper before the institute on methods of gearing, seemed to consider that it had been sent to the last resting place by the experts who tested some of Prof Fleming Jenkin's devices.

No one seems to notice that every day, and on every railroad this method of transmission gets the roughest possible testing; that every locomotive pulls its train by frictional adhesion; that rail and driving wheels are neither more nor less than a frictional rack and pinion. When we try to copy the work of the locomotive under other conditions, our troubles begin. But no man who has ever seen a freight engine climb a grade has any right to speak with disrespect of frictional gearing.

The real root of all the difficulties with frictional transmission seems to be that the pressure producing adhesion does not vary with the dimensions of the gearing; so that

[1] Read before the American Institute of Electrical Engineers, June 19, 1888; published in Nos. 3, 4 and 5, Vol. 3, Western Electrician. Discussion by the institute, October 9, 1888.

when we reduce the size and increase the speed of the gearing the friction at the journal bearings soon becomes enormous. For light work this is partly obviated by using, instead of metal, some more adhesive material, such as paper, rawhide, etc. But none of these surfaces will stand a pull at all comparable with that on the surface of a locomotive driving wheel.

The most promising methods would appear to be those in which the pressure is prevented from acting across the bearings. This idea is carried out to some extent in the well known V grooved gearing; but the unavoidable sliding and grinding of the surfaces make it impossible to obtain a high duty from it. The idea is more fully carried out in the devices of Sillers, Jenkin, and others. I do not know that anything has been suggested--I certainly cannot suggest anything—which does not leave, for the purpose under consideration much to be determined by trial. Knowing well the effect which actual trial is apt to have upon untried devices, I cannot blame an engineer who prefers to let well enough alone, if a fixed speed ratio is all that he cares for. But I cannot help thinking that a suitable connection, which left the speed of the motor independent of the car, would be a valuable acquisition; and that a probability of obtaining it would amply justify further experiments with methods of gearing.

Mr. Pope: I might say, in connection with this note of Mr. Robinson's, that he was present at the meeting at which Mr. Reckenzaun read his paper, and he told me personally that he was much interested in the subject of frictional gearing, and he felt that it had got a black eye from Mr. Reckenzaun's paper.

The Chairman: We should be pleased to hear from Mr. Ries of Baltimore, who is present with us this evening.

Elias E. Ries: It is not often that a paper upon so broad a topic contains so much solid meat within, comparatively speaking, so limited a space as the one that we are here this evening to discuss. Mr. Sprague deserves to be congratulated upon the ability and thoroughness with which he has presented the subject, and I take pleasure in adding what little I can to the discussion of such of its features as it seems to me require more elucidation

The paper, generally speaking, may be divided into two parts, one dealing purely with the municipal rapid transit problem as determined by the conditions that obtain in New York city, and the other with regard to the construction and operation of ordinary electric street railways. I shall take up the latter phase of the paper first, and then, if time permits, will have a few words to say on the general subject of rapid transit as applied to the requirements of New York city.

Mr. Sprague refers to several methods of converting the momentum of a train into useful current, one of these consisting in converting the propelling motor or motors of a train into braking generators when running on a down grade or coming to a stop, and returning the current generated back into the line for the purpose of assisting other motors. This method necessitates raising the counter e. m. f. of the motor until it exceeds the direct e. m. f. of the line, and as this latter is 400 or more volts, it will be apparent that only in a few exceptional cases is the train energy or momentum sufficient to develop in the motor or motors anything above the initial electromotive force for any appreciable length of time. During all this period the energy of the train is simply being expended in overcoming the direct e. m. f., or in other words, in preventing the entrance of the line current to the motor by developing the 400 or more volts necessary to oppose it, a result that can be as readily obtained without the expenditure of this energy by simply opening the motor circuit. The practical effect of the method referred to will be to partially brake the train, but except in a few extreme cases the line current derives no benefit or assistance therefrom. There is, however, another and more economical method of conserving the surplus energy of a railway train, which avoids the loss of the bulk of this energy and at the same time permits the utilization of this energy upon the train itself at times when it is most required. This method, as developed by me some time ago, consists in the employment of a secondary battery so arranged as to be connected with the motorcircuit whenever, as in stopping or descending a grade, the connection between the line and the motor is interrupted, and the latter is in condition to generate a current under the influence of the momentum of the train. The battery cells are connected in parallel or multiple series order during the time when they are in circuit with the generating or braking motor, so as to oppose an electromotive force of only a few volts to the charging current thereby making the movement of the train or car instantly available for charging the battery, this charging process continuing until the speed of the armature has been so reduced by its own braking action upon the train or car, that it is no longer capable of generating the few volts necessary to effect the entrance of its current to the storage battery on the train or car. In this arrangement an automatic potential switch of special construction prevents the closing of the charging circuit until the e. m. f. of the current from the generating motor exceeds that of the battery which occurs almost instantly, and breaks the connection when the e. m. f. of the charging current falls below that of the battery, the entire arrangement being so simple as to require no attention whatever on the part of the motor man. The current thus reclaimed on descending grades and stops is, in the Ries system of electric railways, employed to assist in operating the train or car when ascending grades and starting from a position of rest. The battery, or such portion of it as may be set aside for operating the motor or motors, is of course discharged at a higher voltage, and can be used for electric lighting and all other train purposes to which it may be applicable. It will thus be seen that a two-fold effect is obtained, since the surplus energy of the train which under existing conditions is ordinarily wasted, is not only made to stop the train without the use of friction brakes, but the energy consumed in stopping the train is, with the exception of a very slight loss in conversion, etc., almost entirely recovered and turned to useful account. Mr. Sprague has stated, in referring to the operation of the New York elevated railway system, that 59 per cent. of the power expended by the locomotives on a round trip is used in starting, 24 per cent. in lifting, and only 17 per cent. in traction. That means that 83 per cent. of the total power expended upon the elevated railway system in this city is consumed on account of stoppages and grades, of which nothing is recovered, but on the other hand, the waste is augmented by the use of further steam to apply the brakes. If only one-half, or say 40 per cent. of this wasted energy can by the method above described be recovered, of which I have not the slightest doubt, the value of electrical traction for roads of this character, over that at present used will be apparent, from this standpoint alone.

Another matter of considerable importance is whether one or two motors are most advisable for street car work. I myself am in favor of employing but a single motor directly geared to both axles, and it is the universal opinion of electricians and engineers that in a case of this kind a single large unit is better than two or more smaller ones, and this is especially true in regard to street car motors. A great deal has been said about the difficulty of making satisfactory connection with both axles from a single driving source, but this can be overcome, and I may say I have devised a method of doing this which avoids most of the difficulties heretofore encountered. It is a question whether Mr. Sprague's assertion that independently driven axles necessarily give better track adhesion can be sustained. In fact it seems to me that the reverse is generally the case. There can be no doubt, as Mr. Sprague states, that independently driven axles will slip until they get the best grip, but it is also known that a slipping wheel or pair of wheels will readily continue doing so under the influence of the acquired impetus and the rotative strain exerted upon them by the motor. However, in ordinary street cars the load is constantly shifting from the forward to the rear axle, and vice versa, due to the lurching of the car and unequal distribution of the weight or load. Therefore, supposing a car to be slightly overcrowded at its rear end, the forward wheels must necessarily slip, and the motor driving them will run light for the time being, leaving the rear motor, which was designed to do but half the total work, to do it all and subjecting it to an enormous electrical and mechanical strain.

I have given this subject considerable attention, and have come to the conclusion that for street cars of ordinary construction, the axles should not be independently driven, but should be directly connected with each other, preferably through the armature shaft of the motor itself, whose weight is equally borne by both axles. In this manner the combined tractive effect of all the wheels may be obtained in unison, which will reduce the tendency to slip, and the load upon and work done by the motor will be a constant quantity irrespective of the shifting of the load. For pivoted truck or eight-wheeled cars the objections to independent driving do not so seriously apply, but the advantages of a direct connection with both axles of a truck are even more apparent for other reasons.

I thoroughly agree with Mr. Sprague on the matter of making each car of an elevated train its own motor, provided the motors of the entire train are controlled from a single point. In all cases where stops are frequent this plan possesses numerous advantages, but for trunk line railways having substantial roadbeds a single large motor, or perhaps a front and rear motor suitably connected but capable of independent operation when separated, will probably always be found preferable to a number of small ones

One thing that struck me as very peculiar in connection with the Richmond road, was that an electrical engineer of Mr. Sprague's ability and experience should so utterly abandon all measures of precaution for the safety of his passengers and the public at large as would seem to be indicated by his employment of the track rails and ground as one side of the circuit instead of using a double overhead conductor. This is the more to be wondered at when it is shown by Mr. Sprague's own description of the elaborate and extensive means employed for connecting the track rails and re-enforcing them by separate wires to insure perfect connection with one another and with the ground pipes, etc., that aside from its danger this plan is considerably more expensive than a second overhead wire and double trolleys would be. I can only explain this action on the part of Mr. Sprague, by assuming that he has found the track return necessary to enable him to ascend the steep grades of the Richmond road, by reason of the increased tractive adhesion obtainable due to the passage of the propelling current from the wheels into the rails. If my memory serves me rightly, it was not very long ago--in his address before the American Street Railway association, at their Philadelphia convention last October--that Mr. Sprague stated that on roads having grades of more than six per cent. he proposed to attach a hill horse to the motor car. Whether he intended this as a parting tribute to the usefulness of the patient and long suffering car horse who has so faithfully served the public, I do not know; but at all events he stated that he did not believe it possible for a self-propelled car to get up the hill in any other way. This was some time after I had announced the results of some experiments I had made, both with the electric current and electro-magnetism, in which I was able to show and demonstrate that the tractive adhesion of driving wheels could be very largely increased by these means, sufficient in fact, to enable a motor car to ascend a grade much steeper than any yet surmounted.

However, I might state here for the benefit of Mr. Sprague and others, that this increased tractive adhesion can be obtained without subjecting the public at large to the danger incident to the use of a ground return. Every electrician knows, and perhaps no one better than Mr. Sprague himself, that a ground on any circuit multiplies the danger of leakage, and on electric railway circuit carrying a pressure of 400 or 500 volts, should never be permitted. In the Ries electric railway system we have a cheap and simple method of increasing the tractive adhesion without employing the track rails as a return, which can be applied to any electric railway operating on the parallel system. This consists simply in passing the current from the conduit or overhead conductors, after it leaves the motor, to the forward car axle, which of course is insulated from the car body, and to connect the rear axle, also preferably insulated, to the negative or return conductor. In this way the current, after passing through the motor, must traverse that portion of the track rails lying between the two pairs of wheels, which latter are thus included in the circuit. The portion of the track rails traversed by the current will not act as a ground but simply as a good conductor inserted in the branch or loop that feeds the motor. This is only one of a number of ways in which an increased tractive adhesion may be obtained, but I prefer in most cases to employ a current that is independent of the motive current and of such quality as to produce a very much greater and at the same time a variable tractive effect. I may say that we are at present engaged in applying this system to an ordinary steam locomotive, on a prominent railroad, and if the results obtained prove to be anywhere near what we have reason to expect from certain experiments made on a smaller scale, I shall hope to be able to show you a very decided increase in its pulling capacity, and to effect a considerable saving in the cost of operating the road.

With reference to the ideal method of braking referred to in the paper under discussion, I might state that a modification of our electro magnetic traction apparatus has been applied by us for this purpose. In this we magnetize the car wheels as in our traction apparatus, but in addition provide an electro-magnetic braking arrangement, the whole being so arranged that when the brake circuit is closed, not only are the brakes applied to the tread of the wheels, but the co-efficient of friction between the wheels and the track rails is greatly and simultaneously increased, thereby enabling us to apply a greater brake-shoe pressure than now possible and yet prevent the wheels from skidding upon the rails. This method of braking is effective in almost any weather and is applicable to street cars or to railroad trains. In case where braking is effected by utilizing the motor or motors as braking generators, as before explained, this system is still available and only the traction circuit needs to be established between the two axles of each truck to render it effective. This in my opinion constitutes the ideal method of braking, and before very long I hope to be able to show you such a system in practical operation.

I have already occupied more time than was my intention, and though there are several other matters that I should like to have called attention to, I believe I have said all I want to and will leave something for others to say while I listen. I appreciate and thank you all for the compliment bestowed in calling upon me, and for your kind and respectful attention. (Applause.)

(*To be continued.*)

Cincinnati Electrical Society.

The first public meeting of the Cincinnati Electrical society was held Tuesday evening, Oct. 9th, in Mechanics Institute hall, Cincinnati, O.

The committee of arrangements consisted of F. E. Perry, of the First Cincinnati Edison Illuminating company; F. M Dillie, of the Hauss Electric Light and Power company; J. O. Shiras, secretary of the Merchants Police company; L. W. Davis, of the Queen City Electric company and C B. McMeekin, of C. B. McMeekin & Co., and right royally did the committee, with the assistance of President A. R Foote and Secretary Edgar B Edwards, carry out the work intrusted to them. The event was made notable by the thoughtful, instructive and interesting addresses of Dr Otto A Moses, President Foote, Professor Thomas French, jr., of the University of Cincinnati, President E. D Warfield and Professor Henry Snyder, of Miami University, and Hon. Job E Stevenson of Cincinnati.

The hall of the Institute was crowded to overflowing at the time appointed for calling the meeting to order, and no small number of those present were ladies. They not only seemed to take deep interest in the addresses, but many of them carried away salient points of the discourses in notes. The gathering was representative of the culture and intelligence of Cincinnati, and made an assemblage that any man of science would have been proud to address. President Foote's remarks in calling the society to order, are appended.

President A. R. Foote's Address.

Ladies and Gentlemen:—I appreciate at its full value, the privilege of presiding at this, your first public meeting. To my mind the most fitting introduction I can give your society to the public, will be to make a condensed statement of the present development of electrical interests in the city of Cincinnati, followed by a few remarks upon the work which the society may undertake.

At my suggestion, your society has collected and arranged the following statistics:

Firms in the electric business or doing electrical work: American District Telegraph Co., Ball Electric Co., Becker Al., Bell Telephone Co., Brush Electric Co., Card Motor Co., Cincinnati Fire Alarm Co., Cincinnati Fire Alarm Telegraph Co., Cincinnati District Telegraph Co., Edison Electric Light and Power Co., Hauss Electric Light and Power Co., Hill Electric Co, Jones C. E. & Bro., McGregor, B., Merkhofer & Reuter, Merchants Police Co., National Automatic Fire Alarm Co., Queen City Electric Co., Schopper F. & Co., Spangenberg Electric Co., Standard Electric Works, United Lines Telegraph Co., Western Union Telegraph Co.

Lighting and power stations. Ball Electric Co., Brush Electric Co., Edison Electric Co., Hauss Electric Light and Power Co., Queen City Electric Co., Spangenberg Electric Co.

Motors. Acme Printing Co., Ransley's Ice Cream, Centennial Building, Singer Sewing Machine Co, Jno. Shillito, Volt's Bakery.

Private Incandescent and Arc Light Plants. Dennison House, 75 incandescent; Bend Hey, 100 incandescent; Jung Brewery, 60 incandescent; Moerlein Brewery, 450 incandescent; Walker Brewery, 75 incandescent; Proctor & Gamble, 860 incandescent; Egan Co., 250 incandescent; Schreiber L. & Co., 10 American Exchange; Crane & Co., saw mill, 130 incandescent; Lane & Bodley, 55 incandescent; Cincinnati Screw and Tap Co., 45 incandescent; Sebastian, May & Co., 30 incandescent;

Betts Steam Furnace Co., 90 incandescent; Hoffonhoff & Lauer, 6 arc; Cincinnati Wire Nail Co., 336 incandescent; Cincinnati Corrugating Co., 75 incandescent; Foulds Flour Mill, 40 incandescent; *Commercial Gazette* 400 incandescent; *Enquirer* Office, 480 incandescent; St, James Hotel, 450 incandescent; Morrison & Co., 450 Hauss incandescent; Burnett House, 450 incandescent; American Oak and Leather Co., 550 incandescent; Enterprise Carriage Co., 3 arc; Jno. Van Range Co., 180 incandescent; Cincinnati Type Co., 150 incandescent; United States Custom House, 1000 United States incandescent; Golden Eagle Cloth Co., 30 incandescent; George Bonte, 50 Mather; Heuk's Opera House, 8 Brush, 150 Mather; Centeonial Building; Battle of Gettysburg, 30 incandescent; Cincinnati, Hamilton & Dayton Railroad; Grand Central Depot, 1250 Edison; Little Miami Railroad; Pugh Printing Co., 450 incandescent; C. E. Jones & Bro., 30 United States incandescent; Jno. Holland, 50 Poland incandescent; Consolidated Tank Line Co., 50 incandescent; Phœnix Bridge Co., 12 Brush arc: Cincinnati & Mariette Railroad; Chamber of Commerce, 1200 Brush arc; Pechheimer Bros., 58 American arc; Cohen & Co , 250 incandescent; Fall of Babylon, 80 arc; Walsh Distillery, 50 Mather; Carlisle Building, 30 Mather; McAlpin-Polk Co., 8 American; Queen City Co., generator for motors, driving motors and motors for exhibitors; Card Motor Co., exhibit of motors driven by a Waterhouse generator; Mill Creek Distillery Co., 60 Edison; Sechler & Co., 150 Hauss: Russell Morgan Co., 30 arc, 250 incandescent; Walnut Hills Cable, 8 Brush; Mt. Auburn Cable, 150 Hauss; Highland House Incline, 10 Brush; Price Hill Incline, 10 Thomson-Houston; Bellevue Incline, Coney Island, 30 American 150 Mather; Hall's Safe and Lock Co., 6 30 Mather incandescent; Princess Rink, 12 American; Jno. Shillito Co., 650 Edison; Haydock Carriage Co.; Cincinnati Ice Manufacturing and Storage Co., 10 American; Baer, Levy & Co., 50 Hauss; Morrison & Co., 150 Hauss; Waterhouse Electrical Co., 8 dynamos and 215 lamps; Western Electric Co., 8 dynamos and 200 lamps; Mather Electric Co., Cincinnati Edison Illuminating Co., and Queen City Electric Co., each, two 500 light dynamos and 1000 lamps; Poland Electric Co., private exhibit of one incandescent plant; Spangenberg Electric Co., same.

Engines. Buckeye Engine Co., one 300, one 125 horse power; Russell & Co., one 125 horse power; Atlas Engine Co., one 200 horse power; Ball Engine Co., one 125 horse power.

The City and Suburban Telegraph Association and Bell Telephone Exchange of Cincinnati, Ohio. Officers: A. D. Bullock, president; George N. Stone, general manager; C. G. Gove, secretary; C. T. Dickson, Treasurer; *Directors,* A. D. Bullock, C. T. Dickson, George L. Phillips; George N. Stone, C. H. Kilgour, C. G. Gove, John Kilgour, A. Erkenbrecker. Telephone exchange established September 1, 1878. Number of exchanges Cincinnati, 3; Covington, Ky., 1; Hamilton, O , 1; total number of miles of polelines, including a radius of about thirty miles around Cincinnati, in Ohio, Indiana and Kentucky, 419; total number of miles of wire in the same district, 4,982; total number of circuits, 2,744; total number of subscribers, 3,279; average connections per subscriber per day, 15. *Employes:*—Number of operators, 90; number of inspectors, 16; number on re-construction, 23; number in other positions, 13; total, 142. Rates per year, $40, $50, $60, $72, $84, and $100. Average cost of operating, per subscriber, including royalty, $60.21, per annum.

To show the relation these interests bear to the electrical interests of the whole country, I take the following statistics from the address of S. A. Duncan, president of the National Electric Light Association, at its last convention. There are now eight journals published in this country, devoted exclusively to electrical interests. To-day, there are 5,351 isolated plants and central stations for electric lighting; 192,500 arc lamps and 1,925,000 incandescent lamps are burned in the United States every night, employing in their operation 459,495 horse power of steam. There has been an increase of the capitalization of electric lighting investments, in six months, of $42,210,100. There are finished or being constructed, 83 electric railroads, having 327 miles of single track, operating 467 motor cars. It is estimated that 17,046,500 passengers will be carried on electric railroads in the year 1888. There are factories employing 1500 hands each, devoted exclusively to the manufacture of electrical motors.

Incomplete as the data given by President Duncan is, and considering as it does, but a few branches of the electric industry, it is sufficient to arrest the attention of every observer of events, and to fill the mind with wonder at what has been accomplished.

I can find no statistics, regarding the use of stationary motors, sufficiently complete to admit of tabulation. To give an idea of the development that has been made in that direction, and its future promise, I will state that there are 290 such motors in use in the city of Rochester, New York, alone, and that motors made by a single company are now doing daily service in over 125 different employmeots.

To get something of an idea of the service being rendered by electricity in the United States, we must add to the above the fact that there is not a village, town or city without its telegraph offices and telephone exchange.

To enumerate all the electric appliances, and their uses, that are to day, in one form or another, serving the people of this country, would fill a large volume.

When such facts as these are considered, one may well pause to wonder why it is that we speak of the electric industry, as being in its infancy, and why we are just now organizing a society to promote electrical education. It is because the history of the industry is but beginning to furnish sufficient data, by which to guide the course of events. It is because enough results have been obtained to furnish a substantial foundation for future construction. It is because we know that the present is the prophecy of the future.

Electricity, the most subtle, the most incisive, the most powerful of all natural agencies, marks with surest designation, the limitations on its uses. Its imperious demand is, "Comply with the natural laws by which I am governed and I will serve you with tireless, sleepless, harmless energy. Disregard those laws, and I will destroy you instantly. No plea of ignorance of my laws will avail to arrest the execution of the judgment I decree against those who fail to obey them."

In this industry, more than any other, intelligence alone is the pioneer and guide of progress. Electrical education is the foundation of all its enterprises. To-day there is not a person whose interests are not in some way touched and served by the use of electricity, There is not an occupation, in which human intelligence and strength are employed, that cannot be made easier by the use of electricity, and more pleasant for the worker, and more productive for the investor. For this reason, in its true scope and meaning, electrical education means the education of the people.

1st. The working man must be educated, that he may devise, produce, and operate apparatus that is best for its purpose.

2d. The public must be educated, to enable the people to use the apparatus designed for their service, intelligently and without fear.

3d. The law making representatives of the people must be educated, to enable them to legislate properly on all subjects touching the legal regulation of the uses of electricity.

The uses of electricity are limited only by the want of intelligence in producing fitting apparatus for its application. The demand for such apparatus is limited only by the want of intelligence on the part of the public to know how to use it properly. No other industry ever, in so short a time, called into its service as much intelligence, as many workmen, and as large a capital as this. Employing the most powerful and destructive known agent, distributing its force, by a network of wires, all over great cities, where it has established millions of points of contact with the people, its work being done necessarily by uninformed workmen, using untried material, and untested apparatus, its record for safety in use, is to-day a challenge to all competitors. This being a fact, it is an educational duty to let it be known, and thus destroy the occupation of uninformed or interested sensational writers, who are constantly playing on the fears of the people by writing learnedly about the "death dealing wires." Recently our city papers startled the public by an announcement of the awful death of a painter by a shock from an electric light wire. This was put in large letters, and the fact that he had heedlessly and unnecessarily taken hold of the wire, was put in small type. I found fifteen other casualties, reported in the same paper, and not one of them announced in a way to throw the slightest blame on the agent doing the injury. One of our leading papers last Sunday, published an article over the signature of "A Condenser" under the heading "Death in the Wires" which pretends to be a review of a paper read before the National Telephone Exchange association, by Mr. T. D. Lockwood of Boston. This paper, with the discussion following it, is published in full, in the electrical journals. The only reference made by any speaker to anything like "death in the wires" is the following by Mr. Bailey, of Williamsport, Pa. Speaking of the dangers that might arise from dead telephone wires, especially during a thunderstorm, he says: "We have a case of that kind, where a loop was taken out, on one of our lines; the line got charged from thunderstorm, and the lightning followed in, on those open wires, and struck a child, and knocked it insensible. It recovered without any apparent damage." So much for "death in the wires" by "A Condenser." What shall be said of the intelligence or the honesty of the writer of that article?

In the discussion of Mr. Lockwood's paper, Mr Seeley says: "I presume that in New York city, we have a larger number of electric light wires in the air, than in any other city in the world. All systems are represented here." I now give you the testimony of Abram S. Hewitt, mayor of New York city, regarding "death in the wires." In his address of welcome to the National Electric Light association Mayor Hewitt said: Now as to the matter of danger, the newspapers have teemed, during the last year, with sensational articles, pointing out the great danger of the present system. * * * * Now is this dangerous? Will you kindly tell us? I thought it was exceedingly dangerous. I went into office, with the impression that every man who went into a street lighted by a high tension current, took his life in his hands and I was as anxious as anybody to get that removed; but when it became my duty to look into the matter, I found, measuring this industrial element,—call it what you like—some name you must call it, this force, this power—measuring it by the work it was doing, and ascertaining the accidents that had occurred, to my astonishment it was found that we had more accidents daily from horses in the streets, infinitely more; that we had more accidents with steam engines: that even the building of houses in the city caused more deaths every year: infinitely more deaths in this city, than this particular agency. I was therefore driven to the conclusion, that considering the work it was doing, comparing it, if you like, with illumination by gas, that it was positively safer, just as the railway had proved to be safer, than the stage coach, and the stage coach probably safer than walking, for the number of people carried; I found, that with all the difficulties with the thing, the absolute results seemed to show that it was absolutely safer than any other useful agency, at work in this city. I may be wrong, but that was the conclusion to which I was forced. But when I investigated the cause of the accidents, I discovered that they were not due to anything that was inherent in the transmission of the current overhead, but it was rather due to two causes; either the carelessness of the company, in inspecting its installation, and keeping it in good order, or in the carelessness of the person, who came into contact with it, one or the other. I believe that in this city there are but four cases of death, in consequence of any difficulties with the wires themselves. There may have been some other causes, but I think there are only four direct deaths.

With such a record as this at our command, we to-day, in the infancy of our industry, turn the tables on all competitors, and challenge them to show, in the history of the use of any agency or force, as wide a distribution and as safe transmission of energy, for illumination or power as we now show, in the use of electricity.

We want for our society, $500 for a library: $500 for a room, and its furniture, in which to keep our library, and establish our home; $500 for the services of a competent person to take charge of the same, and $500 for sundry expenses; making in all $2,000 for our first year. Our membership entrance fee is $3. The annual dues, $6, making $9 per year income, per member; 225 members will create the full amount of the fund desired, We now have seventy-five of this number. We hope the remaining 125 will send their names to our secretary at once. Any person interested in our work, lady, gentleman, will be welcomed as a member

One of the most practical lessons I ever received was given by my employer when I first entered business life. He said: "Never attempt to invent a thing you can find made." That is good in itself; but had he stopped there, it would have been like a charity sermon, without the collection,—barren of the results. He did not; he gave me ample opportunity to find out what was "ready made" in the particular line in which he employed me.

In our industry, more than in any other, employers can serve themselves to no better advantage, than to afford their employes ample opportunity to find out what has already been done. I think I am right in affirming that, if all the money that has been wasted in needless experiments in the electrical business, had been applied to educational purposes for the workmen, and to the increase of their pay, as their intelligence rendered their services more valuable, it would have been sufficient to have provided all that is possible to provide, as a means of education, and to have doubled the wages of every working man receiving the benefits of the education. The time will come when, as a matter of business policy, capital will seek to insure the success of its enterprise, by educating workmen for the work they are expected to do; as it now insures itself against loss by fire, or other calamity. In the electrical business there is no greater calamity to be feared, than the uninformed workman. He is a producer of calamities.

I say to all employers, especially to those employing men in electrical work, there is no use that you can possibly make of the same amount of money, that will give you as much satisfaction and as good return on the investment as the little necessary for you to employ, to educate the workmen associated with you for the work you want them to do. I say to all workmen, and especially to the members of this society: If there are difficulties in the way of your advancement, remember it is a law of nature, as well as an axiom in philosophy, that "a man acquires the strength of the difficulties he overcomes." Strive to develop your capabilities to their utmost capacity, and be true to the best there is in you. Remember that he whose brain directs with greatest skill, whose hand handles with greatest certainty the tools of his trade, makes them his servant, and works with least effort. More than this: by skill of brain and skill of hand he makes capital his servant also. Learn to use the language of action—prompt, united, intelligent action—and you will render yourselves invincible. A word is a sound in the air. An act is a fact in history—a fact is an epitome of God. If God made you, he meant you. If he has given you work to do, it is his work that you are doing, and his work is divine. Show your respect for yourself in the work you do. If that is an honor to you, then the universe shall do you honor.

Ladies and Gentlemen: In the olden time when the world was younger, the wise men came from the east on the occasion of a notable birth. To-night is the birthnight of our society, and we have with us a wise man from the east. No star hung over the birth-place to guide him, but he was guided here by that wish for peace and good-will among men, which I know fills his heart, and his heart was the motor. You will all share with me the pleasure I feel in introducing Dr. Otto A. Moses of New York city.

DR. MOSES' ADDRESS.

Members of the Electrical Society—Ladies and Gentlemen: That very flattering introduction has touched me, and I do not know what better I can do than adopt for my text a most pregnant sentence from the gentleman's address, which struck me as he gave it; I will read it to you again. "The uses of electricity are limited only by the want of intelligence in producing fitting apparatus for its application. The demand for such apparatus is limited only by the want of intelligence on the part of the public in knowing how to use it properly." I do not think I could have had a more fitting introduction to the subject which has been selected for me to address you upon to-night than this thought. The only limit to the use of electricity is the want of intelligence in making apparatus for its application; the demand is only limited by the want of intelligence on the part of the public. The function of this society, as I understand it, is, first, to enlighten yourselves, and second, by a reaction to enlighten the public. You have not far to go in the history of this world to begin the history of electricity; some of the very first steps that were taken in it, and some of the greatest, were made by one of our fellow-countrymen. A lot of apparatus had been sent over from England by a Philadelphia gentleman, a member of the Royal society, to Philadelphia. Benjamin Franklin received it, but he did not know exactly how to utilize it to the greatest advantage. His whole object in life was to turn everything to some purpose of utility. In order to make this apparatus available, he founded a society very similar to this which you have organized. The outcome of that society was through the work of Franklin principally, but he also found coadjutors in some of the fundamental workers in the science of electricity. The apparatus consisted of a small electrical machine, two or three insignificant Leyden jars, several small vials, and some glass rods—that and the few notes coupled with it, that came over with the apparatus of the Royal society, were all the material they had to act upon. It was not long before Franklin developed those laws, and studied them, which are now known to be fundamental. I cite this to show how a spirit such as actuates you now can bear the most abundant fruit.

I will cite another instance. About the year 1825, there was a young man of humble parentage, and what is far greater than birth, of humble mind—Michael Faraday, of the same stamina as Franklin. He was incited to action by attending a lecture on the subject of electricity given by Sir Humphrey Davy. He immediately gathered together a few friends and formed what was known as the Philosophical society in London. They made their experiments as Franklin did. Faraday, who was characterized by the class poet, as the "philosopher ingrained," conducted these experiments. It is said that he used to put the kitchen table in a prominent place, putting the cat on one side and the dog on the other. and would then address them on the subject of electricity; that was the first beginning of that society, which afterward budded and bloomed, and from which have come several distinguished men, none more distinguished, however, than Michael Faraday. Now, you have there a very pleasant retrospect. You have that much gained; you have all the wealth of knowledge that is contained in the works of these two men, with hundreds of others, and to you belong now the action and the opportunity to carry forward what they have done. I know no better way of doing it than by imitation. Science, moral, political and social, depends upon evolution. You, gentlemen, to-day, in all your seeming humility in organizing a small society, have back of you and in you a knowledge which at first may not be apparent to you, but which is your heritage; the thing for you to do now is to utilize it to the utmost. Life is very short—science is like art, very long. The tendency of the age is to specialize, and you, in forming an electrical society, think that branch of science enough to cultivate. I would in the very beginning try to eradicate that idea from your minds. All science is interwoven. You might compare the whole sea of knowledge to air, which, while it has the same properties, may be under different pressures on different portions of the earth. It may be stormy in one place, it may be warm in another; it may be cold; it may expand, condense, be full of moisture, bringing and taking away from one part of the earth to another, performing about the same function, and yet apparently at times most contradictory. Science is very much like that; you may imagine you are pursuing one branch of it, when in reality you will find it very closely related to other very remote and almost invisible branches of it, but yet there is an invisible connection, as there is between all things in nature; between the members of a congregation, the residents of a city, the population of a country; the whole world is one, and we again but a part of the whole.

In the pursuit of this study of electricity I would like to direct your attention to something which will facilitate you in bringing about this desideratum cited by your president. The uses of electricity are limited only by the want of intelligence in producing fitting apparatus for its application. I would say to the gentlemen forming this society that they should pursue certain plans—if they wish to make this society as useful as it can be—in first storing their minds with all the information that is necessary for the proper explanation of what exists. This power of electricity which incites action is so simple, furnishes you admirable opportunity for the propagation of force. Force of any kind is inchangeable, and you must study in the present mechanical applications of electricity, what relation it may bear upon the propagation of force in all its forms.

Let me say in parenthesis, that electricity, of which I know not the cause, beyond the great first cause, contains in it the most wonderful form of power that can be imagined—for this reason: it is not produced until it is wanted. All other forms of energy that we apply have to be stored. Electricity may also in a way be stored, but it is a force that may be applied at any instant, and in its application only is produced. I would call attention to that one fact as being the basis of all these inventions that you have been engaged in developing, and which you propose to improve. Any one standing on an elevation in a city like this can see about six o'clock in the evening great volumes of steam arising from the innumerable steam whistles; this wasted force shows one of the great disadvantages in the power of force. Electricity is something that cannot be located except by its effects; it is not present until it is wanted. There now you have a fact which, when developed, is going to change the nature of all mechanical appliances that are used at present by modern civilization. Nearly every instrument for the propagation of power that is employed to-day has to be based upon and connected in some way with a transmission from an engine, chiefly a steam engine. It is possible only to transmit that power by belting, by gearing. or by direct mechanical contact with the source of power, but such is not the case with electricity. You will see for instance a railroad car traveling 25 or 30 miles an hour taking off messages from a wire located some distance from it; being applied to communicate with people a hundred miles off; being applied in fact to talk with them, without any apparent direct communication. Think now of a power which can be utilized without any apparent direct contact with the moving parts, and you will at once see that it is going to revolutionize all forms for the transmission of power for such purposes. There you have to start from the beginning, you have to get rid of this idea of continuity of mechanical action. I was at the *Herald* building recently and saw one of those great thundering presses turning out countless thousands of papers, with the regularity that only a printing press has. In the center of every machine there was a light like this (gracefully indicating an incandescent lamp), and as the machine moved the light went always with it, and if the slightest accident had happened it would have been possible to detect it in a moment; ten minutes' interruption in the printing of the New York *Herald* would cause them not to be able to distribute their paper throughout the country. Things have to be managed with such absolute accuracy that the pressroom is like a military ward; you see men standing at their posts; speaking is forbidden; every eye waiting to detect a possible accident. Now let us carry that simile further. Instead of being compelled to connect these presses with belting that may be thrown off from a pulley or gearing that might break, it is put in direct connection with the machine itself. The printing press and the electric machine being one—does that not mean the remodelling of the whole printing press system? I have a friend who is foreman in one of the largest printing press companies of the country—a man of considerable electrical attainments—and he is all the time harping on the possibility of making an electrical press. Two or three days before I left New York a gentleman, a mechanic of great ability, said that he had enjoyed an hour stolen from his work, in which he had witnessed the operation of a type-setting machine. He said the type would rise up and something would fling it across the room; he saw no power by which this type was drawn; it seemed to work automatically. Here now was a machine setting and making type, without any apparent machinery about it. Quite recently I saw a steam engine with a dynamo machine attached to it. I could not tell where one began and the other ended, but it had struck the mind of the inventor that a steam engine could in its very birth have in view the production of light. I prophesy that the day is near when every steam engine is going to be in some way connected with a dynamo machine, because after you have a steam plant there is very little difficulty in utilizing more of the stored energy in the production of light. Let that be constantly before you—that in the production of your engines you may also couple the dynamo with them.

You should make this electrical society the means of self-improvement—that is to say, if any one of you has an idea in an electrical direction bring it before the society. Some one has said, that "by indirections, we find directions out." Bring any idea that suggests itself to your mind; bring it before the society, and debate upon it. Have you experiments to try? Do not confine them to your laboratories and little workshops at home. Conduct your experiments together. The contact of minds elicits truth. The mere statement of a fact clarifies it. Do you wish to know how little you do know? Try to express what you do know. There is nothing more difficult anyhow than to determine how limited our knowledge is, and it is only when you tell a child what you want to tell it, that you find how little you do know. I have a couple of little inquirers at home, and they often put posers to me. I frequently surprise them by telling them how pleased I am to be "posed." Bring your experiments to each other. Have you any doubts? Ask some one to solve them for you. Have you any certainties? Let some one disprove them. The safest condition of mind is one of suspended judgment. Do not be too certain about the experiments you make. Do not think you have discovered new forces, but if, as once happened to Faraday, some one should come to you and say, "I have discovered a new force," say, "For heaven's sake, no." Let us diminish those we have already. They are all interchangeable; where they begin and where they end it is very difficult to say, but be not discouraged; anything that looks now to be new or that suggests something that might be new, bring it in and spread it before your society. Do not let your society be a cut and dry sort of thing. Do not come with the papers full of the thoughts of other persons. Bring your own thoughts; do not be afraid of them because they come right there naked before your critics. When you think you have found something new, come out in humility and ask some one to undeceive you; that will lead him to try and find fault, and through that clashing of intellect, you will get the truth.

I recall a remark that was made once by an inventive friend. He said in his experience at college and in the world of science, he never met but one man who knew exactly what the limit of his knowledge was. That man was one who may be familiar to you—a man who used to work with very slight materials, but who has made great discoveries—Dr. Wollaston. His apparatus, as Faraday mentions, consisted of a little tea tray, with a blow pipe and a bit of charcoal, but he was very skillful in the use of that blow pipe, and by means of it discovered several new elements. Now, be careful in finding out as definitely as you can what you know, and what you do not know; the limit of what you do not know is infinite. Ask each member to bring some fact to these meetings—some of these hard kernels of fact your president refers to. A fact is like a little grain of gold that can be hammered out into a very large sheet, but it is all gold. I recall a saying of Dr. Johnson, which has impressed me very greatly: "If we look through the hours that are spent in the necessary avocations of life, the calls of friends, of nature, of sickness, we find very few, perhaps not one in the day that can be said to have been entirely and exclusively devoted to our improvement." Look back at the end of a day and see how many facts you have learned at the end of that day; you will find there will not be so many, and yet facts are the materials out of which knowledge is built. Never take a fact for granted; imitate. Faraday, who, if any one came to him with an experiment, would say, "Let me do it;" the very fact of doing it fastened it upon his mind. We recall things that we see, but it is very difficult to recall a thing that some one has told us that we have not seen, and for this reason, that we have to take his conception of it. I never look at one of those incandescent lights without a feeling of awe. I had the pleasure of showing the first one of these outside of the laboratory lights, at a meeting of the Mining engineers in Philadelphia, in 1881. I grew up in it—had my hands in it, but I never lose my respect for it. I never can look at that silent work of God without a feeling of awe, and I thank God that I have that sensibility that I can take pleasure over and over again in seeing so wonderful a manifestation of His power. Never lose your respect for a fact, and the best way is to familiarize yourself with it by seeing it develop into something that can affect your senses.

There are other things that you should bear in mind. Electricity is not alone the object of your pursuit. You are developing yourselves in other directions by the study of this branch of science. You must not think that you are to educate yourselves for electricity alone. All education is as much interwoven as the forces of nature. Bring any fact before your society, but let the main facts be those for which your society was formed—practical electricity.

You are very fortunate, gentlemen, in organizing your society at a time when you have in your beautiful city so excellent an exposition as the one I visited this afternoon, and I visited it with great pleasure, I assure you. I think it a liberal education to have studied that exposition. You have a great advantage there. Study all the things that are in it, and you will find one of these days some means of applying your electrical knowledge in connection with it. There is scarcely a thing there but can be coupled with the science that you intend to develop. That exposition is an education; all you have to do in connection with it is to apply many of the things that at first sight strike you as just mere accidents brought together, but you will find that there is a connexus between them all. I saw quite a number of electrical machines there—some very excellent ones, and I congratulate you upon having had your hands in some of them. Some of those motors and dynamo machines that I saw were excellent, and showed that you have here inventive talent in this city that needs simply the stimulus to develop into very considerable results.

The first experiments made in electric lighting and the distribution of power date back within the recollection of us all. In fact, as was said, the Centennial exposition of Philadelphia closed in the evening for want of an electric light; and that is but twelve years ago. To-day you see electricity permeating everywhere. Sir Wm. Thomson at that exposition heard with wonder and so described it when he addressed the British association on his return to England. He heard—almost "heard and not heard," as Tennyson says, because I really believe his imagination aided him in it, but he heard murmurs over the telephone for the first time. That was at the centennial in Philadelphia twelve years ago, and now it ramifies like the nerves through our body over this vast country. What could we do to-day without the telephone? Gentlemen, I look to see the day before I am many years older when I here can call up any one I want to in the United States; this strikes you as wonderful, but I want to be able to throw myself in communication with a friend at a distance, so that I may make him cognizant of the fact. It is a very simple plan—but all great inventions are very simple things, as Bacon said of "printing—a gross invention;" gunpowder—"a mere accident," and yet see how they have changed the face of the globe; they have developed civilization, and somewhat hindered it too. The telephone will be the means of throwing us into communication with any one we please. I give you this to think of in your leisure moments so that you may develop it. The one defect to-day in the telephone system is the fact that two individuals cannot throw themselves into communication; there must be the intermediary of the central station; that will be obviated within certain districts, and I give you that as a thought upon which you can spend a great many useful moments in developing a way by which you can communicate with any other individual in the circuit. Now that the central station is a necessity, let me show you an application of it. Suppose I wish to be thrown into communication with some person in Atlanta, Ga.; I know that that person is going to Atlanta; don't know that he is there, have not seen him for a month, but when he does get to Atlanta I want to talk with him. I immediately telephone to the central station in this city: "Please communicate to the Grand Central Station of the United States, wherever it may be, say Cincinnati," my wish to be thrown into communication with Mr. A when he reaches Atlanta. The central station here telephones to Atlanta, and says, "When Mr. A presents himself at the station, please throw him into communication with Mr. B in Cincinnati or New York." Mr. A, when arrived at Atlanta, goes to the first telephone station and registers himself, and finds out that I am asking for him. He rings me up directly from Atlanta, and we get into communication. You can readily perceive that with the use of the long distance telephone, such a state of affairs can be brought about in a very few years. Then recall the fact that it is but twelve years ago since the telephone was first used, when Prof. Thompson heard it for the first time. Conceive of that, and see beyond the application for the distribution of intelligence, what electricity has done?

It will be possible by some of the systems now in vogue to store electrical energy at some of the great centers of power in the country—say the slack coal heaps of Pennsylvania or the coal mines of Pennsylvania or Alabama, the water powers of New York, and from those points to be able to distribute force which can be converted into any manifestation of it that you please. What is to be done to accomplish it? Simply to carry ont a little further than now developed the methods by which electrical force is communicated to a distance. It is a very simple proposition. All that you have to do is to convert a primary source of power, whether it is the motion of water or the motion of atoms brought about by chemical combinations, as in the burning of the coal into a condition that it is ready to act or not act. In the secondary battery you have such opportunities. The most pregnant field that I recognize at present for you to explore is that of the transmission of energy to a distance. You have all the data, and while you are making machines for that purpose, consider the importance of them. I look to see the day very shortly—I am surprised that it is not now here—when the city of Cincinnati will be ablaze with electric light. I admired your beautiful city to-day when I walked through it for the first time—saw magnificent blocks of buildings, wide streets, a busy population—lighted by gas. I thought when the enormous development of this electrical industry in other cities is considered, that you are either too timorous or that you have not been brought to understand the value of this new manifestation of the force. I know the intelligence is here. I see by this assemblage a desire to burst these bonds or trammels under which your intellects and capital have been held for so long a time, while other cities have been developing both. The night before I left the city of Pittsburgh I wandered through the streets of that town with a friend, and I was amazed to see the enormous development of electricity. I recall having been there four years ago, and it was in about the same condition that Cincinnati is to-day. I look to see next time I visit you that you will have taken steps in the direction toward the use of this wonderful power, and that you,

gentlemen of the electrical society, will have been the means to have enlightened the population of this city.

There are various uses to which this power can be applied that are yet in embryo, but there are several of them to-day offering the greatest inducements for the application of capital. When you consider that the gas lighting industry is the largest manufacturing industry in the world, you will see how readily the wonderful application of electricity for the production of light will be the means of creating a new industry, because only one fact is wanted—one of those stubborn facts which cannot be denied—and, if you are fortunate enough to discover it, you will be the means of changing the gas lighting industry into the electric lighting industry in an instant. You have simply to improve the flame that is in this lamp to that extent that you will be able to produce twice as many candles to the horse power. Do that, and you have in one night supplanted the largest industry in the world by another. Now it is no cruel thing to say that I wish that will be done. I do not say it in a selfish spirit; but in this hall the air is fresh and sweet, which condition is largely due to the absence of gas. We are accustomed, when we feel an evil to which we have become habituated, to lose sight of its being an evil, and we do not often recur to the fact; we try to take it as one of those unavoidable things—just as when we are fatigued—it is our poor human nature We have admitted into our households in gas one of the most poisonous agencies that I can well think of. It is there to be turned on at an instant by careless children and servants. We are being poisoned by it all the time. Let one of you try to make a perfectly tight joint, and you will find that it becomes a high art. You cannot prevent the leakage of gas. It will take place imperceptibly. We feel overcome by a lassitude, and we do not know why—malaria! Nine times out of ten it is gas. There is in gas of all kinds, and in some of the most improved forms of gas, carbonic oxide, which is highly poisonous, and if taken into our systems the effects will gradually undermine our constitutions. That is in an indirect way one of the disadvantages of gas. The supplanting of that by electric light will be of great advantage. You are to think of something to do away with that, but as I say, not altogether in a selfish way. Blessed is the man who makes money out of a desire to be a benefactor to his fellow men. The whole axis of the world turns on the exchange of commodities. He who introduces something that is useful, that has shown itself to be of value in other parts of the world, becomes a public benefactor. The greatest manifestation of force which God has given to us, which more than anything else of His handiwork resembles Him, is electricity. Take it and utilize it, and look upon it as the coming means of changing the civilization of this age. You have, gentlemen, a great deal of the future in your hands, if you only utilize the means. It is a subject of very great interest, and I am glad you seem interested in it, and I hope what I have suggested in my feeble way will be carried forward.

At the conclusion of Dr Moses' address after the prolonged applause of appreciation had subsided Professor Thomas French, jr., was called upon. He complimented Dr Moses in the expression that he was not anxious to speak, but preferred to depart ith the thoughts of the previous speaker, to think over them quietly. He referred to the phenomenal growth of electrical industry, and urged the necessity of young men, through the medium of the society, fitting themselves for the work ahead of them.

Hon Job Stevenson followed with a most happy off-hand speech and Professor Snyder closed the literary part of the evening's programme.

At the close of the exercises in hall, those present wended their way to the Palace Hotel, where a fine luncheon had been laid in honor of Dr Moses. After the disposal of the luncheon a few informal toasts were responded to.

CORRESPONDENCE.

New York Notes.

NEW YORK, Oct. 11.—The controversy regarding the electric lights on the Brooklyn bridge still continues, but it now appears that they are likely to remain undisturbed for a long time. District Attorney Walker has written a letter to the attorney general, in which, after reviewing the law and stating the facts in the case, he says: "It seems to me, therefore, that two things at least remain to be done in order to remedy the evils to safe navigation in the East River by reason of improper lights upon the Brooklyn bridge. First, congress must pass an act prescribing a punishment for disobedience to the orders of the Lighthouse board; and secondly, said board must make some definite orders respecting the subject." A representative of the Lighthouse board admitted that no special regulations had been adopted regarding the bridge, but said that this was never done in the case of any bridge. The trustees were, however, supplied with a copy of the general regulations, which were as clear as day on the points involved in this controversy, and the copy also included a colored diagram showing the exact position of the required lights. President Howell, of the bridge trustees, still insists that there is no necessity for screening the lights, and that during the five years they have been used no pilot's voice has been raised against them, but that the protests made are from the same individuals who opposed the construction of the bridge.

The Park commissioners have ordered the Brush Electric Illuminating company to remove the tall masts in Madison and Union square parks, which formerly supported clusters of arc lamps. These tower lights were found to be unsatisfactory for illuminating the parks in summer when they were most needed, by reason of the dense foliage underneath them.

The annual meeting of the stockholders of the Western Union Telegraph company was held in this city on October 10th Although about three-quarters of the stock was voted upon there were but four persons in attendance. Sam Sloan was present to preside. John Terry came in, in time for lunch, while Dr. Green and General Van Horne, both being actively engaged in the building, were of course on hand. The annual report of President Green was handed in, from which it appears that the increase in gross revenue over the previous year was $2,519,254.17, and in expenditures $1,485,923.64, leaving a net increase in earnings of $1,033,230.53. The total additions to the plant were 14,561 miles of line and 91,607 miles of wire, and 1,583 additional and newly equipped offices.

The Herzog Teleseme company has sent a communication to the board of police protesting against the action of the treasurer of the board in returning to the controller the money which had been appropriated for the purpose of erecting electric signal boxes in the city for the use of the police department, and demanding that the contract which, it is claimed by the company, was entered into by the police department be recognized. The company is prepared to put the boxes on the street lamp posts. The communication was placed on file.

Andrew Radel, the ruling spirit of the Newark and South Orange, N. J., Horse railroad, and his father have just returned from a tour of observation of the different systems of passenger conveyance, with a view to the adoption of the best for that line. They were very much pleased with the electrical system at Richmond, Va., and an application is to be made, October 18th, to the South Orange trustees for permission to introduce electricity for traction purposes. It is estimated that the change in outfit will cost about $200,000, which they think can be saved in about five years. If the South Orange experiment is a success, permission will be asked of the council for its extension throughout the entire line.

William Masterson, a collector for the Edison Electric Light company, has pleaded guilty in Part I, General Sessions, to having stolen $4,700 from the company, and Recorder Smyth sentenced him to four years in state prison. The money was squandered in betting on horse races. Mrs. Masterson has sacrificed all her own property in order to make good her husband's peculations.

The first regular meeting of the New York Electric club for the lecture series of 1888–'9 will be held at the club house, 17 East Twenty-second street, Thursday evening, Oct. 18. The address will be delivered at 8:15 o'clock in the assembly room by Capt. E. L. Zalinski, U. S. A. His subject will be "Electricity Applied to Sea-coast Defences."

David J. Hauss, jr., recently of Cincinnati, is now in this city, representing the Hauss Electric company, at 65 Murray street, where he has on exhibition a working model of his electric street railway system, in which one rail is divided into electrical sections 12 feet in length, supplied with current from an insulated wire placed in the wooden stringer underneath the rail. The opposite rail is used as a return or ground. An automatic device in each section switches the current to and from the motor as it passes from one section to another. This arrangement is claimed to be superior for city street railways where overhead conductors are not permitted and underground conduits are expensive. The model has been inspected by most of the leading street railway men in the city. P.

Detroit News.

DETROIT, Oct. 13.—Dr. Charles H. Land of this city has filed a caveat at Washington covering a process for making gas from crude oil. If all that is claimed for the process be true, it will effect a great saving in the mode of heating and cost of fuel. The principle is to so arrange the apparatus to which the process will be applied that air will be supplied for the fire so as to bring about a complete diffusion of oil by a series of tubes and pipes, the result of which is perfect combustion. The heat can be made most intense. This was illustrated here a few days ago. Less than two quarts of kerosene or petroleum kept a muffle furnace of fire brick, ten inches long and four inches in diameter, at a temperature of 4,000° for one hour, the only draught being that afforded by an ordinary chimney. Dr. Land is still at work on the process, and has already secured several patents. He contemplates forming a company to introduce it into iron, steel and brass foundries. It will also be of great value to jewelers, assayers, dentists, and the arts generally.

Articles of association of the Michigan Phonograph company, capital stock $300,000, have been filed with the county clerk. Levi Barbour, C. C. Bowen and others are the incorporators. C.

Indianapolis, Ind.

INDIANAPOLIS, Oct. 13.—The Jenney Electric company reports a good business. Last week it shipped a 30 arc light outfit to Astoria, W. T., and closed a contract with the Gas company at Sidney, O., for a 30 arc and 300 incandescent light plant.

One of the Indianapolis new papers is agitating the underground wire subject. In last Saturday's issue it says: "Interviews to-day with several of the leading electricians elicited information which goes yet further to prove the feasibility of burying wires without the necessity of constructing costly conduits," and gives as a practical illustration of this fact a description of the way in which the Jenney Electric company has run its wires for the arc lights used along the approaches to the new Union railway station. The wires were first covered with a coating of okonite, then wrapped with galvanized wire, and buried in a shallow trench.

Several members of city council went to Lafayette, Ind., last week, on invitation of the McNeal Street Car company to witness the operation of the electrical street railroad at that place. At a special meeting of city council Monday night the McNeal ordinance was passed. This ordinance allows the company to lay its tracks on certain streets in the south part of the city; to use either overhead or underground conductors and further stipulates that the company shall operate an electric light system and place a 2,000 candle power lamp at each street crossing along its lines, for which the city is to pay $30 a year each.

The Brush Electric Light company have taken down the 90 feet towers erected some three or four years ago on Washington street at the corner of Illinois and Pennsylvania streets.

The Coleman Stove company of this city has put in electric lights at its shops, and is working day and night to keep up with orders.

One of the features of a political parade here to-day was a large number of employes of the Jenney Electric company, who carried staffs, each of which had an incandescent lamp on the end.

At Anderson, Ind., the city council, in special session, October 11th, ordered the removal of all telephone poles and wires from the streets and alleys within fifteen days. This action was taken as the Central Union Telephone company had refused for more than a year to furnish service at the legal rates prescribed by the laws of Indiana. M.

THE ELECTRIC LIGHT.

The Thomson-Houston company of Chicago has sold an incandescent plant to Leroy Payne, Chicago.

John Mohr & Sons, Chicago, have ordered a 25-light arc plant of the Thomson-Houston company of Chicago.

The Thomson Houston company of Chicago has sold an arc plant to the Armour-Cudahy Packing company, South Omaha, Neb.

The St. Paul, Ga., company has purchased fifty arc lights of the Thomson-Houston company of Chicago as an increase to the present plant.

The Brush Electric company have sold to Carson Bros., Charlotte, N. C., through W. A. Wright, special agent, an incandescent electric light plant complete.

W. A Wright, representing the Brush Electric company, has sold to Granite Falls Manufacturing company, Granite Falls, N C., an incandescent electric light plant complete consisting of 225 lights.

The Roaring Fork Electric Light and Power company, of Aspen, Col., have recently ordered from the Brush Electric company, Cleveland, Ohio, several 2,000 candle power Brush arc lamps, with which to increase their plant.

W. A. Wright of Greenville, S. C., representing the Brush Electric company, has sold to the Virginia & Norfolk Wheel company Richmond, Va., an incandescent electric light plant consisting of a 75 light dynamo, with full complement of lamps.

The Pennock Battery Electric Light & Improvement company is giving exhibitions of its system of operating incandescent lamps by primary batteries at the office, 110 Quincy street, Chicago. The room is fitted with several lamps of different kinds. The light is certainly of marked brilliancy, and the exhibition is attracting considerable attention. The company has already installed several plants in the city.

Among the recent sales made by John H. Reid, Chicago manager of the Mather Electric company, are the following: E. F. Wickert, Neenah, Wis., 500 incandescent plant; Union Cold Storage & Warehouse company, Sixteenth and State streets, Chicago, 200 incandescent plant; A. G. Spalding & Bros., Chicago, 50 incandescent plant; George Wrise & Son, Wentworth avenue and Twentieth street, Chicago, 75 incandescent plant.

The representatives of the electric lighting companies of Boston conferred last week with the committee of the Boston Board of Fire Underwriters in regard to the adoption of better insulation on the wires they have strung over the city. The result of the conference was, according to the *Standard* of that city, in a manner satisfactory. The electric light men thought that much of the danger of wires crossing could be obviated by the appointment of an inspector, by the city, who would inspect and enforce the proper hanging of telegraph and telephone wires.

THE ELECTRIC MOTOR.

The East Harrisburgh Passenger Street Railway company of Harrisburgh, Pa., has ordered an additional equipment of four cars of the Sprague system.

S. D. Green, electrical engineer of the Sprague company of New York was in Boston last week superintending the construction of the overhead system of the West End railway, Brookline branch.

Last week the Sprague Electric Railway & Motor company of New York closed a contract with Nelson Bennett, president of the Tacoma, W. T., Street Railroad company for the entire electrical equipment of that street railway. The system will be the regular Sprague overhead, with the small No. 6 wire as a working conductor, which is a feature upon all the Sprague railways. The cars will all be brilliantly lighted by electricity, will be furnished with all the latest Sprague improvements, and will have the new improved Sprague trolley wheel. The cars will all be protected from lightning by improved lightning arresters of the latest pattern, which provide perfect immunity from this source of danger.

THE TELEGRAPH.

Benjamin C. Higdon, night manager of the Western Union Telegraph company's office at New Orleans, died October 10th.

The Postal Telegraph operators in New York have sent a considerable fund for the Western Union telegraph operators of Jacksonville. The subscription paper states: "During the epidemic of 1878, 75 per cent. of the fraternity who took the fever died. Wives were left widows, children were left orphans, and in several cases whole families were almost entirely swept away. The same fate has been within the past few weeks the experience of several of our brethren's families at Jacksonville."

Personal Paragraphs.

Jean A. Wetmore, representing the Okonite company, was in Chicago last week.

Mr. Jealous, electrician of the Washington mills, Lawrence, Mass., has gone to Paris to inquire into the electric lighting of that city.

J. W. Johnson, formerly of the Northwestern Accumulator company, has taken a position with the Western Electric company, Chicago.

W. J. Tipton, who has been connected with the electrical department of the New Haven Clock company, has taken a position with the Western Electric company, Chicago.

Frank Stewart, who left his position with the Western Electric company of Chicago, has re-entered the service of the company. He will represent the company in the sale of electric light plants.

George A. Redman, superintendent of the Brush Electric Light company of Rochester, N. Y. addressed the members of the Academy of Science, Oct. 8, of that city on electric light and power.

James L. Jayne of Jackson, Miss., has been appointed agent for California and Nevada by the Sprague Electric Railway & Motor company of New York. Mr. Jayne will enter immediately upon his duties there. He is a young man, thoroughly versed in electrical engineering, and will be a decided acquisition to the company with which he is connected.

Business Mention.

James W. Queen & Co. of Philadelphia, Pa., have issued a very large and complete catalogue of chemical apparatus. The book numbers 364 pages, and is profusely illustrated. There probably is not a stock of goods of this character in the country as complete as that carried by James W. Queen & Co., consequently purchasers have a very wide range to select from.

The Southwestern Electric Supply company of Kansas City, Mo., has just issued a catalogue, covering electric light, telephone and telegraph supplies, electric annunciators, bells and burglar alarms, motors, gas lighting apparatus and a line of general supplies. This company has the southwest for its field, and can offer its present and prospective customers a choice line of goods.

The Standard Underground Cable company of Pittsburgh, Pa , has just issued a pocket handbook of useful information regarding Standard underground cables. The book is well illustrated and is valuable enough to warrant the assertion that it should be in the hands of every cable user. The copies intended for general distribution are bound in a tough check with rounded corners, which will bear the hard usage to which a constant pocket companion of this character is subjected, while copies for special distribution are bound in leather. The book is catalogued as "No. 6."

W. W Munro, Chicago agent of the Baxter Motor company, has recently sold motors to the *Plowman* publishing company, of Moline, Ill.; the Porter company of Moline, and the *Daily Argus* of Rock Island Several orders have recently been received from St Paul, which is becoming an excellent field for motors. "We have just sold the forty-fourth motor in Chicago," said Mr. Munro a few days ago. They are used in seventeen different kinds of business. Do you realize that Chicago has taken hold of the motor business more vigorously than any other city in the country? Since the commencement of the business here six months ago, a great many more motors have been sold than during an equal period in any city in the country."

The Standard Electrical works of Cincinnati, O., are endeavoring to keep up with the demand for hotel annunciators of the Hess style. The company finds it difficult to do so, but is striving to do its best. It has on hand orders for five annunciators of this type for hotels. This same company has found it entirely out of the question to keep up with its orders for pins and brackets. For six months it has not caught up with the trade in this line. The company holds the Cincinnati agency for the Okonite company, and among its recent orders for this wire received one for the okonite used in the Brush plant now being installed in the splendid Chamber of Commerce building in Cincinnati. The value of the wire sold for this plant is placed at $2,500.

The Union Indurated Fiber company, New York, have recently shipped some 50,000 feet of their pipe to the Bell Telephone company of Philadelphia. This is now being laid in Market street, and so much to the satisfaction of the telephone company that they were ready to place an order for some 200,000 feet more, which the fiber company were obliged to decline on account of their inability to deliver rapidly enough. This pipe is described as pressed out from wood fiber and treated so as to render it impervious. Its advantages for underground work are obvious. It is attracting much attention in Philadelphia, and a crowd of the curious are constantly examining it as it lies in the street. The company have recently received a letter from General Greely of the Signal Service, relative to the merits of the fiberite battery jars furnished the department. These jars are reported upon by Lieut. Frank Greene of the Signal Corps, in charge of the telegraph division. Lieut. Greene considers these fiberite battery jars an excellent substitute for the glass ones which have been in use, as they will always retain their shape, are much easier to keep clean and renew, and are not liable to breakage from freezing or violence in transit.

Electric Patents.

Issued Oct. 9, 1888.

390,642. Mechanical Telegraph John B Bennett, Indianapolis, Ind.

390,674. Galvanic Battery. David Humphreys, Cincinnati, O.

390,675. Galvanic Battery. David Humphreys, Cincinnati, O.

390,676 Galvanic Battery. David Humphreys, Cincinnati, O.

390,677. Galvanic Battery. David Humphreys, Cincinnati, O.

390,721. Dynamo Electric Machine. Nikola Tesla, New York, N. Y.

The field magnet is wound with independent coils, each connected with a source of alternating currents, so that the magnetic poles produced by said coils will be progressively moved through the field; the armature core is wound with independent coils, each having terminals from which currents are delivered to the independent external circuits.

390,741. Insulator or Bracket Support for Electric Wires. Thomas E. Adams, Cleveland, O.

The insulator is provided with a curved body having a grooved head at one end and a canopy at its lower end. The groove and the canopy are preferably placed in parallel vertical planes.

390,748. Battery Electrode. Horatio J. Brewer, New York, N. Y.

390,778. Electric Bell-Pull. Philander A. Harris, Paterson, N. J.

390,795 Electrically Operative Lock. Gustave S. Neu, New York, N. Y.

390,802. Telegraphy. F. Jarvis Patten, Fort Sidney, Neb.

390,820. Regulator for Alternate Current Motors. Nikola Tesla, New York, N. Y.

390,833. Hotel Signaling System. Albert Barrett and Joseph Zentner, Kansas City, Mo.

Signals may be exchanged between the office and the different rooms, while the clerk may send a general alarm when danger threatening the guests should require it. Claim 6 reads "The combination of an electric circuit, a split battery in said circuit, a local normally open branch circuit a current indicator in said branch, and switches in the main circuit for throwing either section of battery into the branch circuit, whereby the strength of either section may be tested, and current still be maintained on the main line."

390,846. Globe for Electric Arc Lamps. William W. Downing, Peoria, Ill.

380,891. Electrical Stop Mechanism for Knitting Machines. Andrew M. Newlands, Galt, Ontario, Can.

390,903. Incandescent Electric Lamp. Albert L Reinmann, Pittsburgh, Pa.

The invention consists in employing a conductor, the section passing through the glass being flattened through the greater portion of its length and of greater width and less thickness through the portion within the the globe. This secures the required firmness of the leading-in wires within the globe and secures a seal through which the required currents may be transmitted.

390,904. Electro Dynamic Motor. Elias E. Ries, Baltimore, Md.

The invention consists broadly of a motor having a divisibly wound armature and a commutator divided into as many separate portions as there are separate divisions in the armature winding. Also in a switch, by means of which the various windings of the armature may be connected or grouped to form as different combinations between the windings as though separate differently wound armatures were used.

390,905. Electro-Dynamic Machine. Elias E. Ries, Baltimore, Md.

The invention consists more especially in the electrical construction of the armatures thereof, which are provided with two distinct sets of coils, one of which is separable into a number of separate coils for the production of desired effects. The machine is adapted for use as a generator, motor, transformer, or as a combined motor and generator, according to the purpose to which the machine is applied.

The multiple winding is preferably placed on the interior, with the series on the exterior, the armature being provided with an iron core, and while the series winding is rendered active by the line current enough power will be developed in the machine, which in this case is acting as a motor, for the purpose of propelling the vehicle on ordinary grades.

390,906. Multiple Current Electric Generator. Elias E. Ries, Baltimore, Md.

The invention relates to apparatus for generating, combining and distributing electric currents, and it has reference to such as is designed to generate a plurality of separate currents, each capable of supplying a separate circuit, but arranged to be grouped in various ways for furnishing current of any desired character to one or more working circuits. The ninth claim is: "The combination with two separate circuits supplied with current from a source of electricity furnishing multiple or divided currents which are substantially equal, of a switch in circuit with said source and with both of said circuits, and arranged and adapted to variably distribute the current between the two circuits in such a manner that the electromotive force rises in the one as the current is diminished in the other, and vice versa."

390,910. Coupling Dynamo Electric Machines for Electric Distribution. Oliver B Shallenberger, Rochester, Pa.

390,911 Regulator for Electric Translating Devices. Oliver B. Shallenberger, Rochester, Pa.

The invention comprises a plan of regulating the current supplied in a system of alternate current distribution to translating devices—for instance, incandescent electric lamps: "Claim 3. The combination of translating devices, a source of electricity supplying currents thereto, regulating coils, a core of magnetizable material common to all of said coils, the coils having a portion of their length connected with said source in series with said translating devices, and a portion connected to the source in parallel with the translating devices, and means for varying the relative lengths of the portions of the coils so connected"

390,912. Apparatus for Synchrinizing Alternate Current Dynamo Electric Machines. Oliver B. Shallenberger, Rochester, Pa.

This patent shows means whereby the effects produced by currents derived from two machines which it is desired to connect with each other may be compared, so that the relative phases may be noted The necessity of handling currents of high potential in so doing is avoided.

The third claim is as follows: "The combination of two sources of alternating electric currents, circuits derived therefrom, respectively, and brought into inductive relation to each other, and a single electric indicator comparing the effects of the currents in the two circuits."

390,921. Carbon Contact or Commutator Brush. Charles Van Depoele, Chicago, Ill.

390,930. Synchronizing Electric Generators. George Westinghouse, jr., Pittsburgh, Pa.

In general terms, the invention consists in coupling the generators with their driving shafts through friction yielding or other equivalent couplings which will allow the armature of either generator to move with reference to its driving pulley or with reference to the shaft of the engine, as may be required to maintain synchronism with the other generators.

390,955. Dynamo Electric Machine. Julius Emmner, Jr., Washington, D. C.

The patent claims a ring or cylindrical armature comprising a drum, a series of sections provided on one side with a tongue or projection, and on the other side with a groove entered by the tongue of the adjacent section and detachably connected thereto, the grooves in the sections extending to one of the edges of the sections in order that any one section may be removed without displacing the adjacent sections. The sixth claim follows: "An armature for dynamo electric machines, comprising a drum and a series of ring sections attached thereto, each section being provided with a tongue and with a groove extending to the edge."

390,960. Apparatus for Automatically Regulating the Flow and Temperature of Fluids. George A Gustin, Washington, D. C.

390,990. System of Electrical Distribution. Oliver B. Shallenberger, Rochester, Pa

The invention consists in connecting a number of translating devices in series with each other, and in connecting in shunt circuit around each device a suitably constructed reactive coil, and in thus dispensing with the converters or potential reducing devices as usually organized,

Claim 1 reads: "The combination, with a circuit supplied by alternating electric currents, of two or more incandescent electric lamps or other translating devices connected in series therein, and reactive coils connected across their respective terminals, the winding of each reactive coil being so related to the mass of iron in its core that upon the interruption of the current through any lamp a normal current is allowed to pass to the other lamps by reason of the consequent high magnetic saturation of the core of the corresponding reactive coil"

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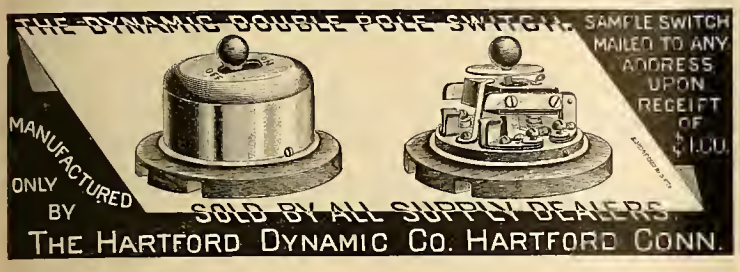

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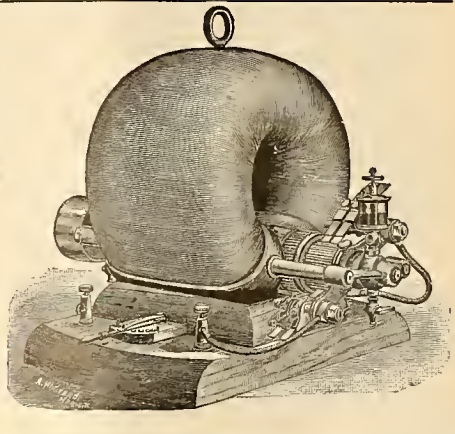

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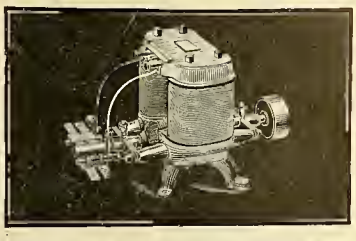

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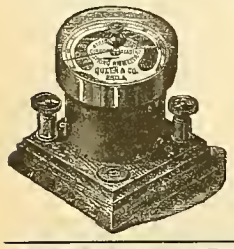

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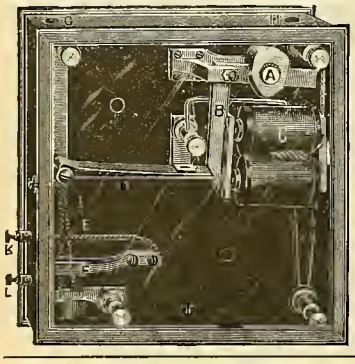

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MAYOR'S OFFICE,
NATCHEZ, MISS., Aug. 27th, 1888.

Notice is hereby given that sealed proposals will be received at the office of the City Clerk until **12 o'clock M., November 1st, 1888,** for lighting the streets, alleys, commons or parks of the city, with electricity, in accordance with plan and specifications to be placed in the City Clerk's office, for the period of five years, that is to say, that portion of the city now lighted with gas, from the 1st day of March, A. D., 1889, and that part lighted by coal oil lamps, from the 1st day of June, A. D., 1889.

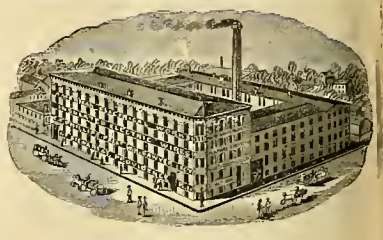
Each bidder is required to file with his bid a detailed statement of the number and location of the plants then in operation, of the particular system which he proposes to establish in Natchez if successful in bidding, and to specify as to each plant so in operation whether it is the one originally established in such locality or has been substituted for some other previously in use, and, if a substitute, then for what system.

The successful bidder will be required to enter into good and sufficient bond, of such penalty as the Mayor and Aldermen shall hereafter fix, conditioned that he will erect and have ready for use the electric plant, and begin the lighting of the city therewith, on the dates hereinbefore stated.

The Mayor and Aldermen reserve the right to reject any or all bids.

W. H. MALLERY,
Mayor of City of Natchez.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.
American Electrical Works.



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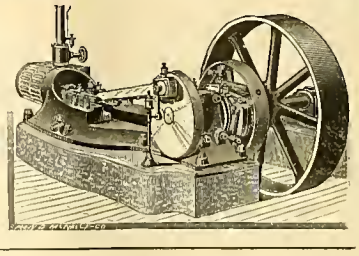

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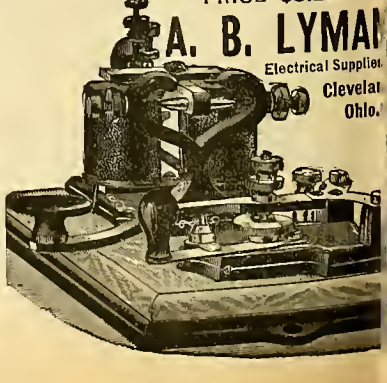

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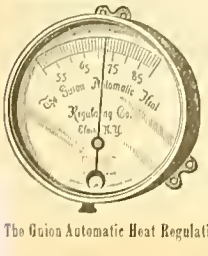

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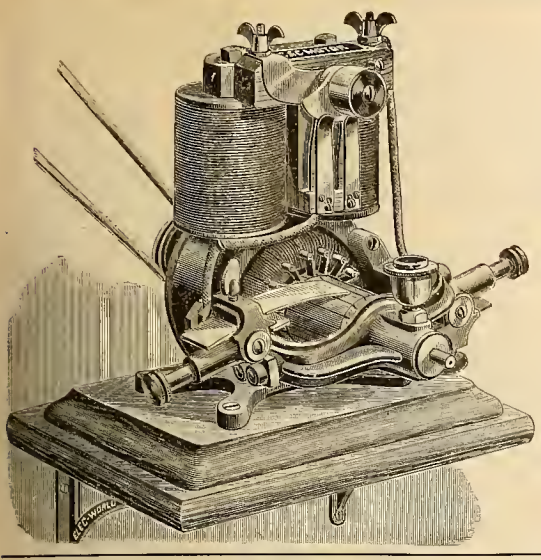

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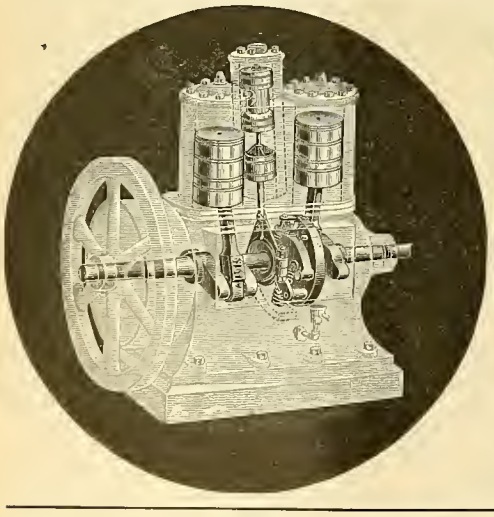

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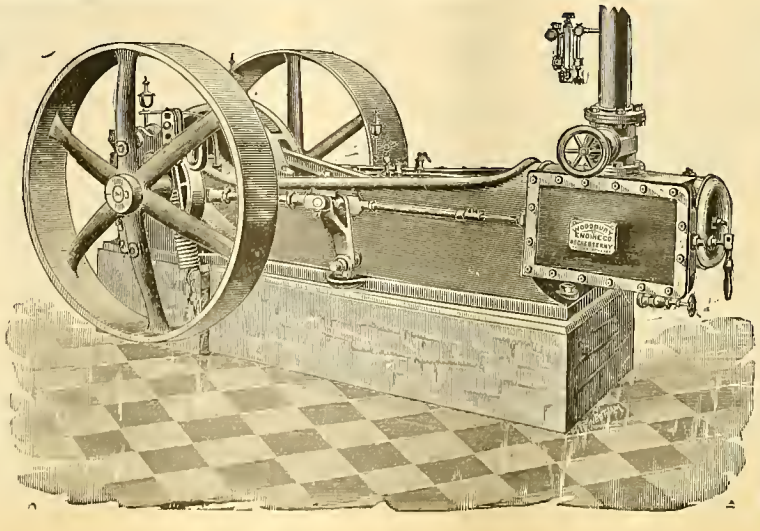

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TABLE OF CONTENTS.

	PAGE.
ELEMENTARY DATA—	
The Electric Current, Chapter I	1, 2
Ohm's Law, Chapter II	2
Work, Chapter III	2
Conductors and Insulators, Chapter IV	2
Direction of the Current, Chapter V	3, 4
Detector Galvanometer and Magneto Bell, Chapter VI	5, 6, 7
ARRANGEMENT OF POWER—	
The Dynamo Room, Chapter VII	8
Motive Power, Chapter VIII	8
Shafting and Pulleys, Chapter IX	9
Foundations for Dynamos, Chapter X	9, 10
Belts, Chapter XI	10
DYNAMO ELECTRIC MACHINES—	
Description of the Dynamo, Chapter XII	11
The Continuous Current Dynamo, Chapter XIII	11, 12, 13, 14
The Series Dynamo	11, 12
The Shunt or Derived Circuit Dynamo	12, 13
The Compound Dynamo	13, 14
The Alternating Current Dynamo, Chapter XIV	14, 15
Preparation of a New Dynamo for Operation, Chapter XV	15, 16
Starting a New Dynamo, Chapter XVI	16
Keeping a Dynamo in Good Order, Chapter XVII	12
Brushes, Chapter XVIII	17, 18, 90
The Commutator, Chapter XIX	19, 17
Repairs, Chapter XX	20, 21
To the Armature	20, 21
To the Field Magnets	21
Testing the Wire Coils of a Dynamo for Contact Against Iron, Chapter XXI	21, 22, 23, 24
DISEASES OF DYNAMOS—	
Non-generation of Current by the Dynamo, Chapter XXII	25, 26
Excessive Sparking of Commutator and Brushes, Chapter XXIII	26, 27
LAMPS—	
Arc Lamps, Chapter XXIV	28, 29, 30, 31
Suspension of Arc Lamps, Chapter XXV	31
Trimming and Cleaning Arc Lamps, Chapter XXVI	32
Incandescent or Glow Lamps, Chapter XXVII	32, 33
Multiple Arc System, Chapter XXVIII	33
Multiple Series System, Chapter XXIX	33, 34, 35
Series Multiple System, Chapter XXX	36
Arc and Incandescent Lamps on the Same Circuit, Chapter XXXI	36, 37 38
The Alternating System, Chapter XXXII	38
INSTRUMENTS—	
Current Indicator or Ampere Meter, Chapter XXXIII	39
Pressure or Potential Indicator, or Voltmeter, Chapter XXXIV	39, 40
Current Regulator, Chapter XXXV	40, 41
Switches, Chapter XXXVI	41, 42
Safety Devices, Chapter XXXVII	42, 43
Lightning Arresters, Chapter XXXVIII	43, 44
Ground Detector, Chapter XXXIX	45, 46
Switch-Board, Chapter XL	46, 47
CIRCUITS OR LEADS—	
Outdoor Leads for Arc Lighting, Chapter XLI	48, 49, 50, 51, 52, 53
Outdoor Leads for Incandescent Lighting, Chapter XLII	53, 54
Arc Circuits Inside of Houses, Chapter XLIII	54
Incandescent Circuits Inside of Houses, Chapter XLIV	55, 56, 57
Size of Wires for Incandescent Lamp Installations, Chapter XLV	57, 58, 70
Testing, Chapter XLVI	58
ACCUMULATORS—	
Accumulators, Chapter XLVII	59
SAFETY REGULATIONS—	
Rules of the Boston Underwriters' Union	60, 61, 62, 63, 64, 65, 66
English Regulations	66, 67, 68
Abstract of the Chicago Electric Light Laws	68, 69
Table of Electric Light Conductors	70
Lamp Lighting Schedule—Moonlight System	71–82
Construction Tools	83-89

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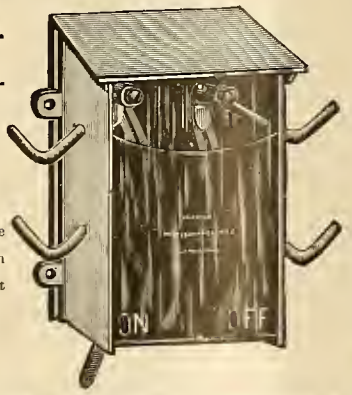

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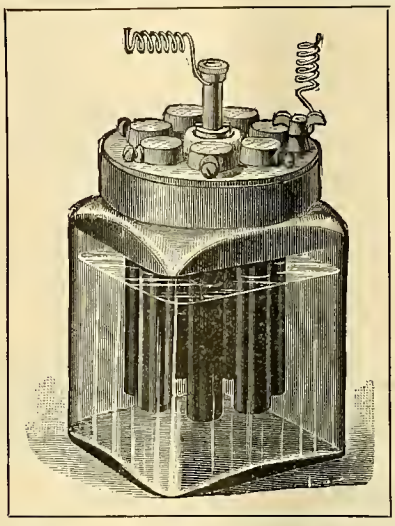

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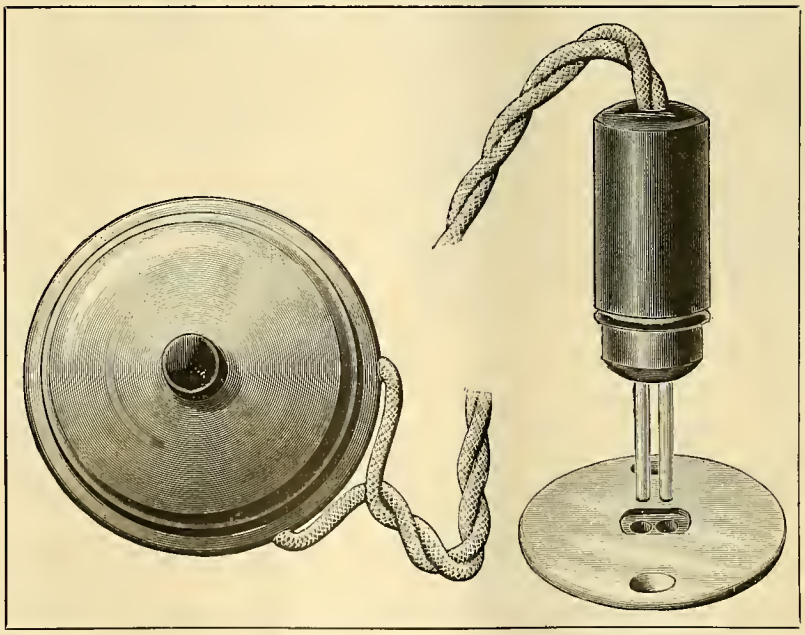

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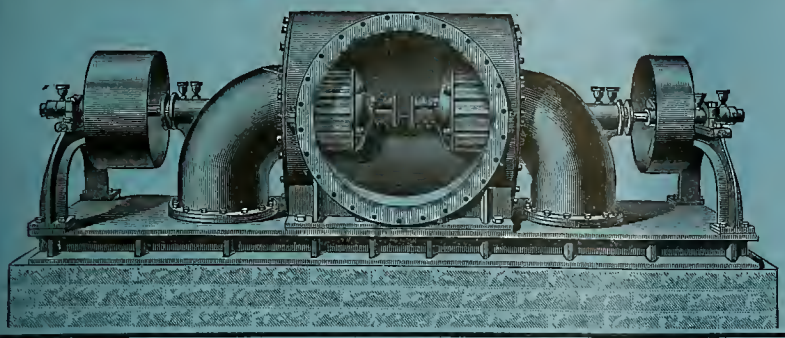

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft, with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

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ELECTRICAL ACCUMULATORS or STORAGE BATTERIES,

Especially Adapted to

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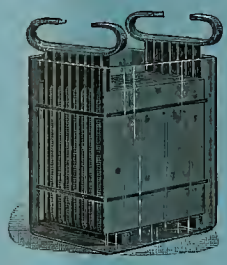
Isolated Lighting, Railroad Car Lighting,

Street Car Propulsion, Long Distance Lighting.



Among the Advantages of this System are:

Absolute Certainty of Light,
Increased Life of Lamps,
Great Economy of Running Expenses,
Absolute Steadiness of Current,
Utilization of Surplus Power,
Adaptability to Existing Plants,

And Complete Displacement of Gas.

Inquiries from NORTHERN ILLINOIS, EASTERN IOWA, WISCONSIN and MINNESOTA should be addressed to the exclusive licensees for said territory,

Northwestern Electrical Accumulator Company,

223 PHENIX BUILDING, CHICAGO, ILL.

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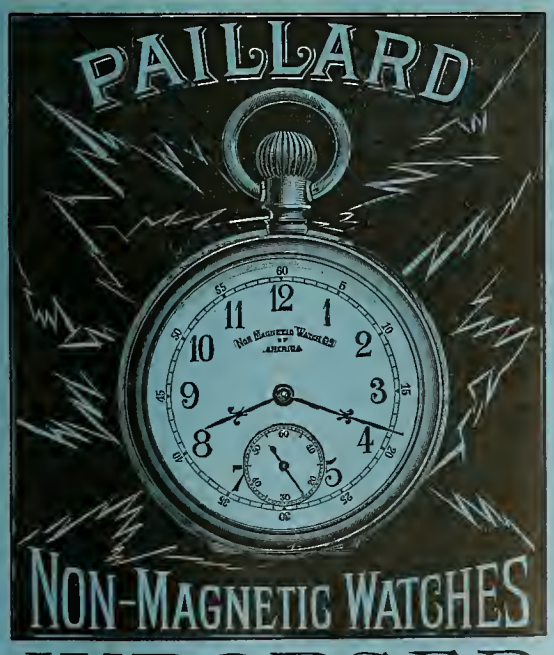
44 BROADWAY, NEW YORK



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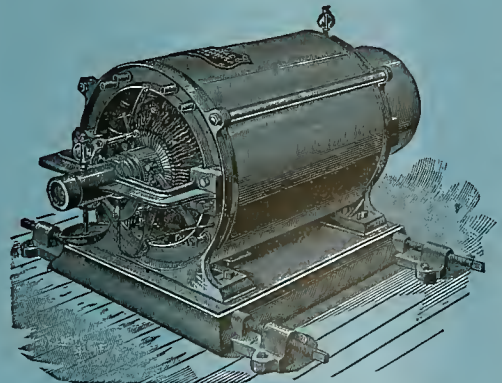
The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



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We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

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SLATTERY INDUCTION SYSTEM

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JENNEY SYSTEM

—OF—

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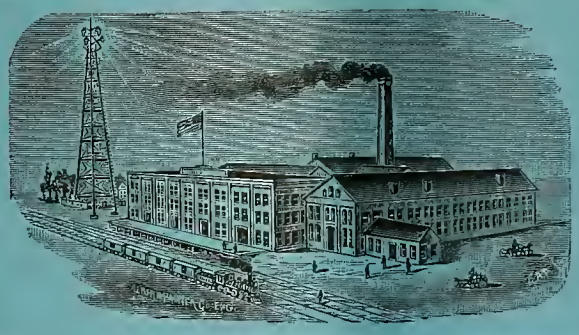

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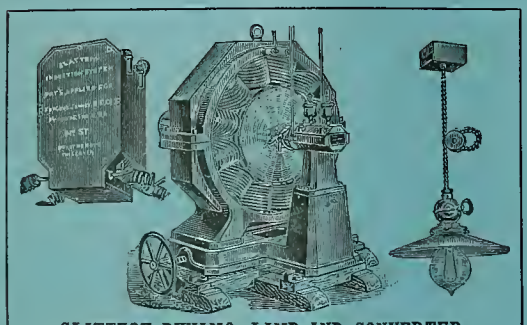

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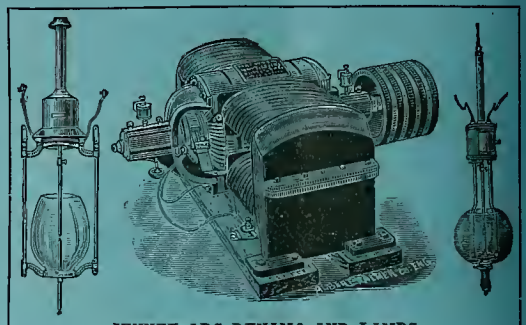

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Very respectfully,

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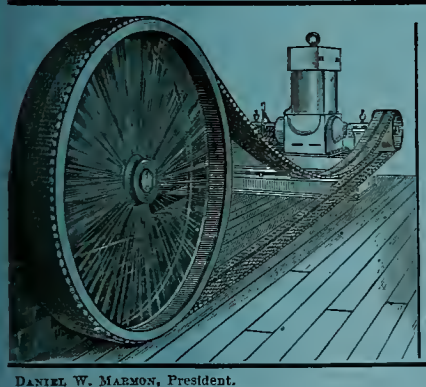

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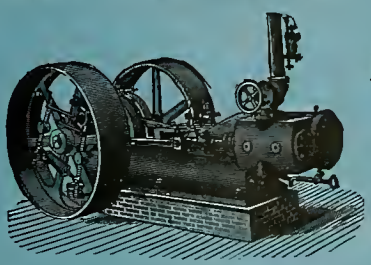

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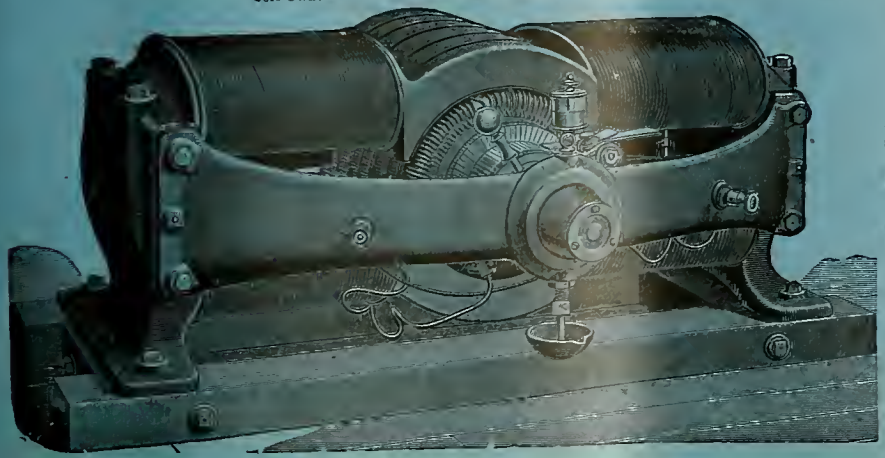

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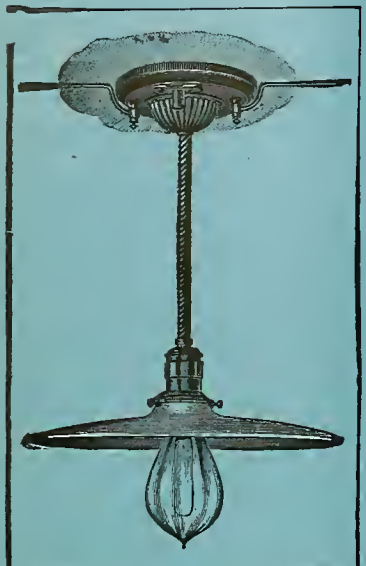

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These Lamps have repeatedly shown their superiority under test.

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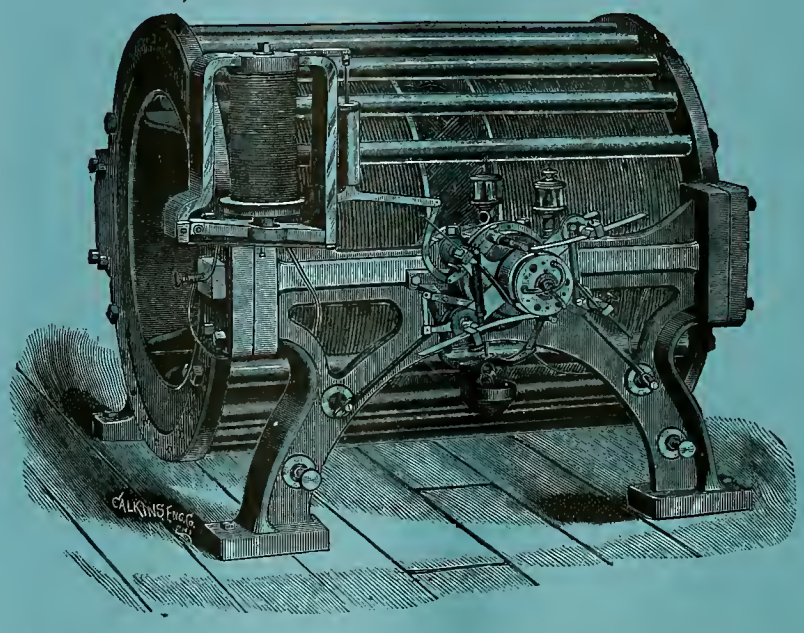

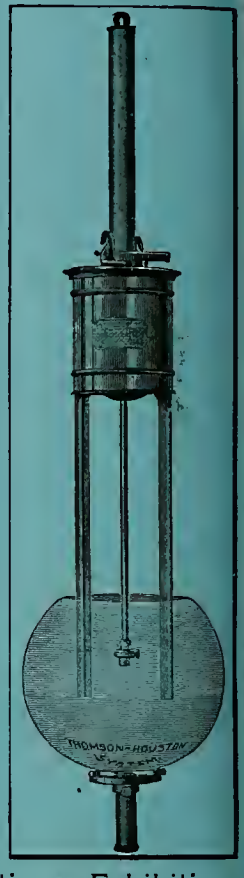

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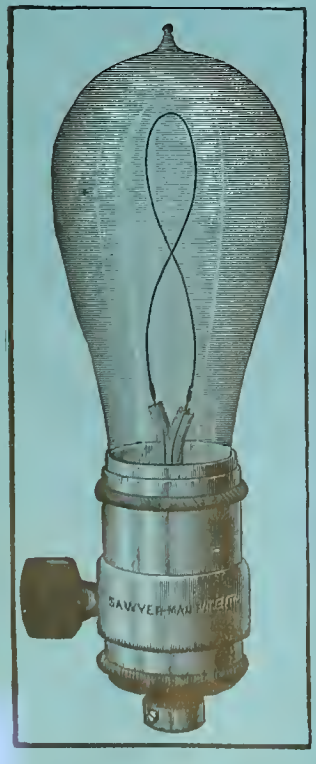
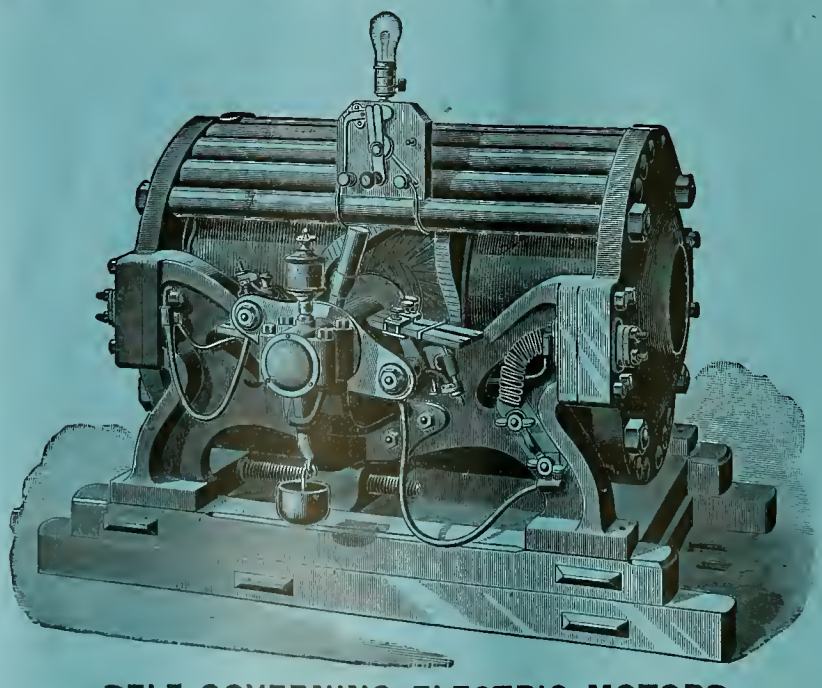
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

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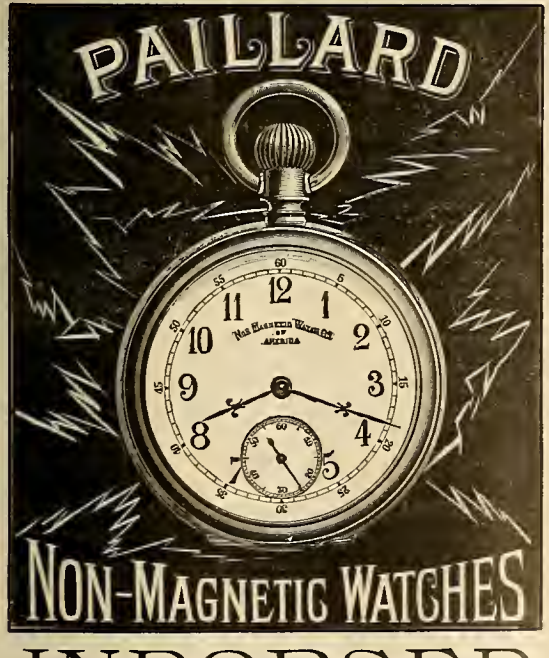

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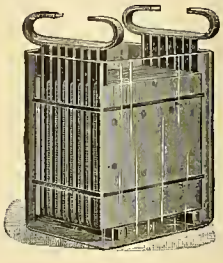

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And Complete Displacement of Gas.

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223 PHENIX BUILDING, CHICAGO, ILL.

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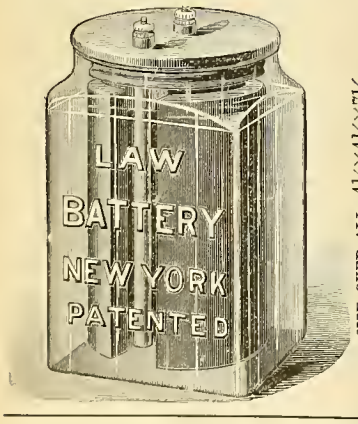
THE LAW BATTERY.



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THESE ARE DECIDED IMPROVEMENTS.

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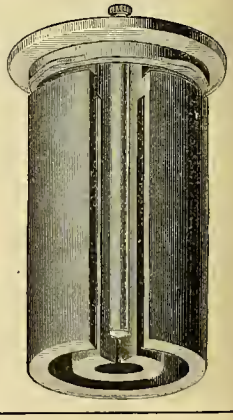

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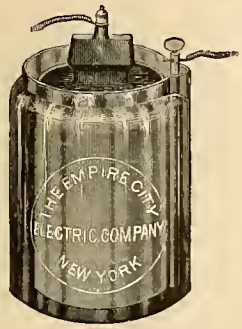

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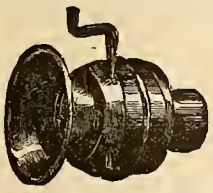

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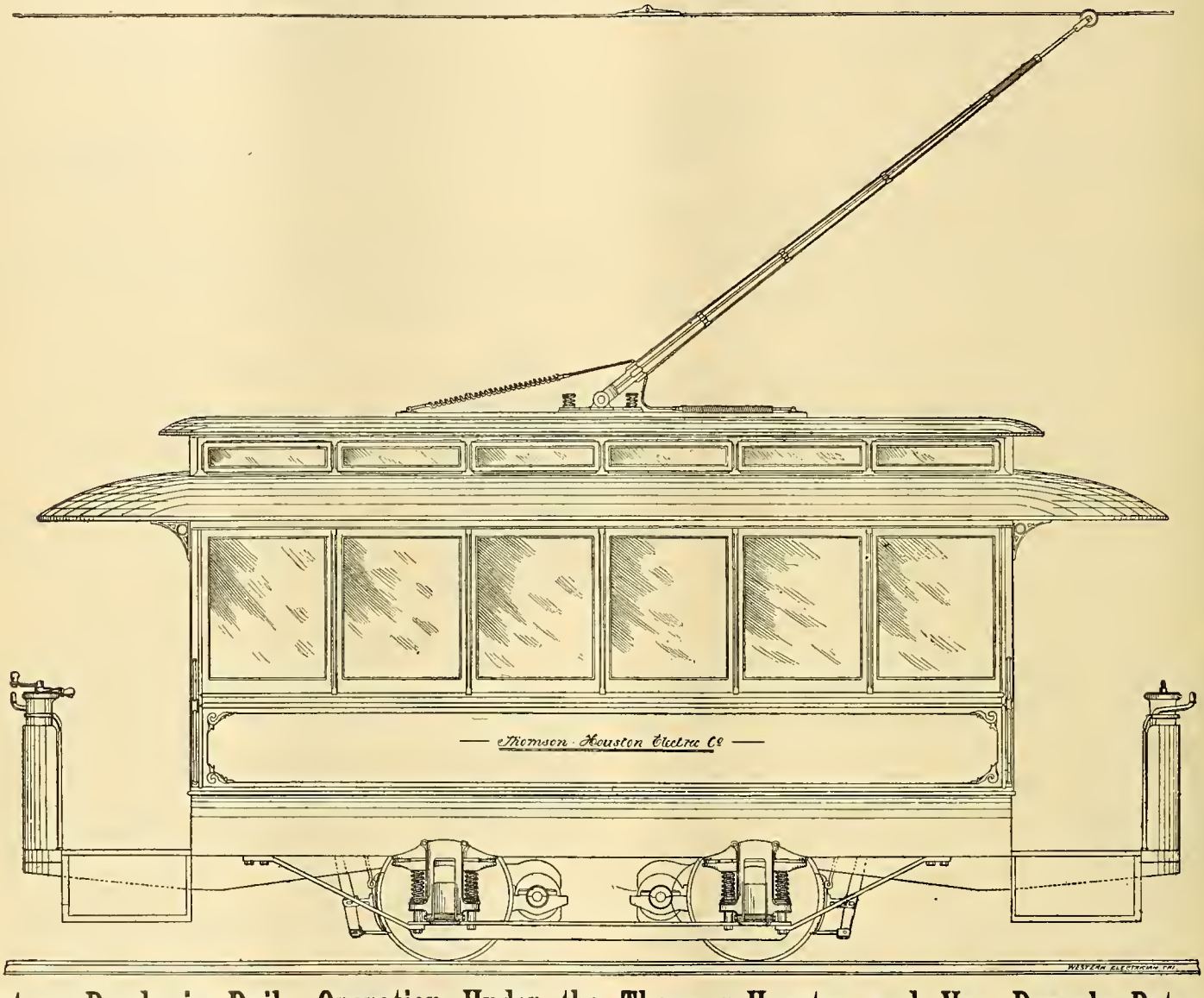

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Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, OCTOBER 27, 1888. No. 17.

The Cincinnati Exposition.

The Cincinnati Centennial exposition, or, as it is more formally termed the Centennial Exposition of the Ohio Valley and Central States, now drawing to a close, will have an important place in the history of electric lighting, as it distinctly marks a notable era. Twelve years ago the Philadelphia Centennial exposition was closed evenings for want of the electric light. The Cincinnati exposition has been open evenings and has both electric and gas lights, though probably if the former had not been available the Cincinnati exposition would have been closed evenings like the Philadelphia exposition. The next exposition of equal importance will probably use electric lights alone.

Never in the history of electric lighting has there been such a splendid exhibit of the novel and beautiful effects that may be produced by aid of the electric light as that witnessed at this xposition. The Edison company representatives, W. J. Hammer, electrical engineer, and Stuart & Altenberg, the Cincinnati agents of the company, outrivaled all previous attempts in bringing out wonderful displays, which not only involved skilled knowledge of electrical engineering, but also a finely developed artistic sense.

A beautiful scene was that in Horticultural hall where there was a cascade behind which a hundred or more colored lights glowed brilliantly. Spanning the cascade was a rainbow of lights of every hue, and in both features marvelous effects were obtained at will, such as the light following each other up and down the falling water or the rainbow appearing, fading and reappearing, or the lights flashing singly or in sections. There was a gigantic Japanese parasol with brilliant colored lights pendant from each rib; innumerable baskets of flowers studded with colored lamps, a monster fountain illuminated in the same manner; lamps floating on and in water; a revolving Christmas tree brilliantly lighted, a monster Edison lamp made of small lamps of the commercial size, and other very attractive features of the same nature.

But these features of the electrical part of the exposition were designed as attractive displays and were to be seen only at certain hours of the day or evening. The large part of the electrical display naturally consisted of the service plants which afforded the general illumination, and it is to these service plants that the illustrations in connection are devoted.

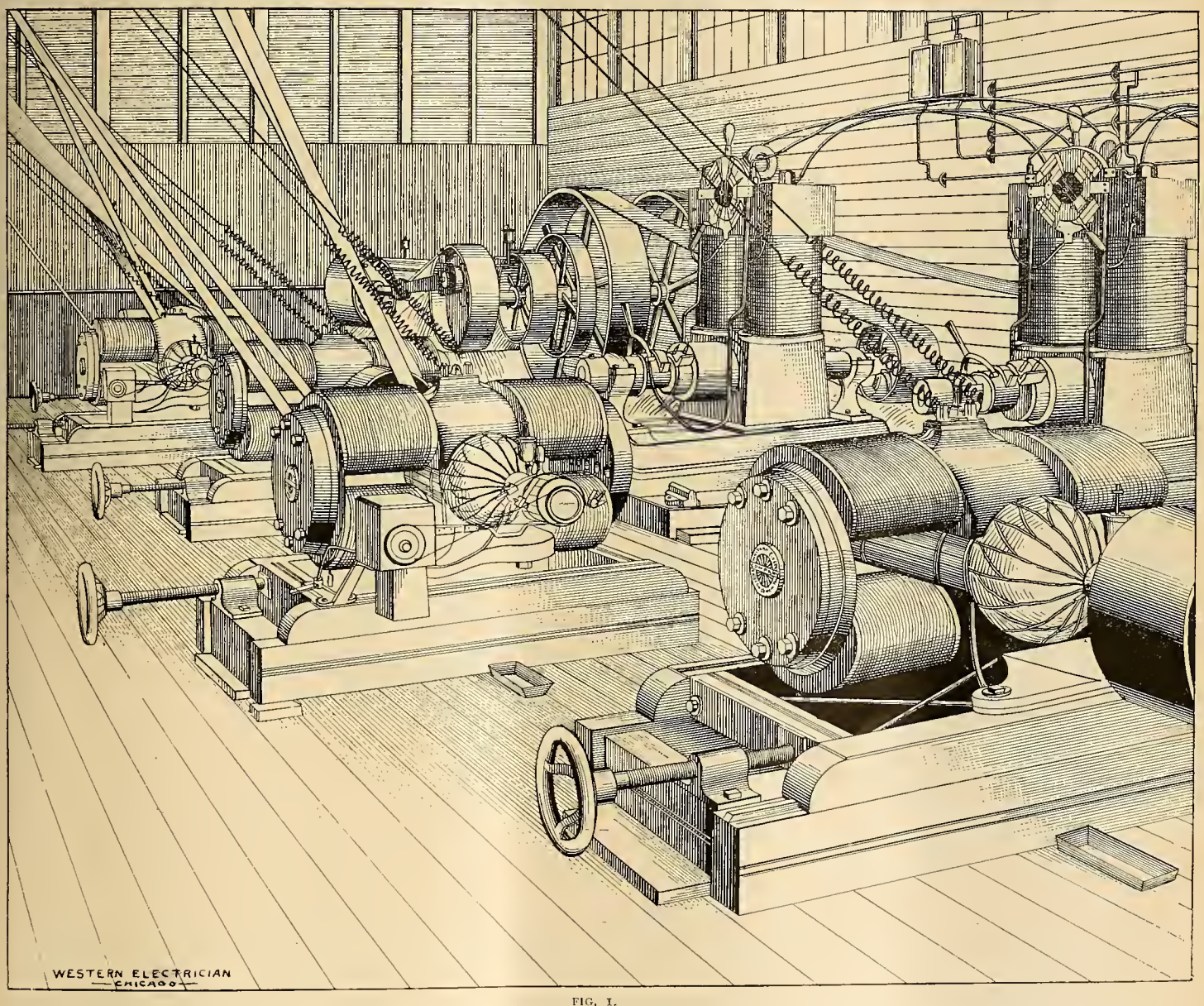


FIG. I.

As one approached the exposition in the evening—to turn aside for a moment from a consideration of the plants themselves—the eye was well nigh dazzled by the brilliant illumination of the approaches for possibly two squares. Of the 17,000 gas lamps in use a large proportion were in the rows with easily curving arches on either side of the street, while upon the faces of the exposition buildings, which are up-

on either side of Elm street, arc lights shed their refulgent rays, taking the place indeed, of the sun. Around the dome of the Park building a dozen arc lights hung in a circle, while on the apex of the roof of a covered bridge across the street was a Western Electric focusing headlight, which shed its fierce rays down the center of the street as far as the eye could reach. The scene was brilliant to the highest degree. The buildings themselves, comprising 600,000 square feet of floor service, were illuminated by arc or incandescent lights, as circumstances dictated.

But to the service plants. When the plants were first installed it was not thought that they would be as extensive as they subsequently proved, and consequently, although the space allotted to the plants was somewhat increased over the original allowance, it proved insufficient, and therefore part of the service plants were to be found in the north end of the Park building, and another part in Pioneer hall across the street from the former building. The illustrations given in connection are from the main dynamo room in the north end of the Park building. Within this room there are twenty dynamos, as follows: Eight Waterhouse 30-light arc dynamos; eight Western Electric 30-light arc dynamos; two Mather 500-light incandescent dynamos, and two Edison 500-light dynamos.

Fig. 1 represents a view taken from the center of the dynamo room, toward the corner in which Western Electric and Edison dynamos are located. The former are seen in the foreground, and the latter in the rear.

Fig. 2 represents a view taken from the same position toward the other corner. Waterhouse dynamos are shown in the foreground, and Mather dynamos in the background.

Fig. 4 shows a ground plan of the dynamo room. W. N. Gray, who was commissioner in charge of the electric department until a few weeks ago, laid out the work in this room in a very creditable manner, and to Luke Lilly, the superintendent, must the credit be given for the thorough installation of circuits.

The steam for the engines in this room is furnished by two Galloway boilers, manufactured by the Edgemoor Iron works, of Edgemoor, Pa. These boilers are 7 feet in diameter and 28 feet, 2 inches in length. The boilers are internally fired and the smoke returns under the boiler to the stack shown at the left of the boilers. Each is rated at 250 horse power.

At the upper right corner of Fig. 4 is represented a 300 horse power tangye bed Buckeye engine, manufactured by the Buckeye Engine company, of Salem, O. The engine has a cylinder 20x33 inches and is speeded at 120 revolutions. At the upper left corner of this cut is represented a 200 horse power Atlas engine, made by the Atlas Engine works. The cylinder is 18x24 inches, and the speed is 170 revolutions. Between engines and boiler and the dynamos is seen the line shaft. Each engine connects to this shaft at the end. One engine drives the dynamos seen in Fig. 1 and the other those seen in Fig. 2, but there is a friction clutch, so arranged that either engine can drive the whole of the line shaft. All the pulleys on the shaft are friction clutch pulleys, manufactured by the Falls River company, of Cuyahoga Falls, O. These pulleys were entered as an exhibit as well as used in service. Their operation is admirable.

At the lower right corner of Fig. 4 is represented a Buckeye high speed engine, cylinder 14x16 inches; speed 250 revolutions. This engine is used to drive the two Edison dynamos seen in Fig. 1. At the lower left corner of Fig. 4 is represented a Russell engine, manufactured by the Russell Engine company, of Massillon, O. This engine is a 14x20 inch; speed, 235 revolutions. Its office is to drive the Mather dynamos seen in Fig. 2.

A Baragwanath heater and a Laidlaw & Dunn standard duplex pump, 7 1-2x4 1-2 x10 inches, are also a part of the equipment of the plant.

The Bradford Belting company and the American Oak Leather company supplied the leather belts used on the dynamos, and Pearce, Atkins & Co. supplied the cotton belting for like service.

Under the line shaft in Fig. 4 are the ammeters, voltmeters, regulators and like instruments for the dynamos. The balcony for spectators is noted on the cut, and it truly should have a place, inasmuch as it is crowded with interested sight seers whenever the dynamos are in operation.

Away over in Machinery hall, which, by the way, is built over the Miami canal, is found one of the most picturesque views of the exposition, and it is reproduced in Fig. 3. The building is 1,300 feet long and through it are distributed a hundred arc lights. The sides of this hall are devoted to the exhibition of machinery, while in beautiful contrast the center is magically transformed into a Venetian night scene with gondo-

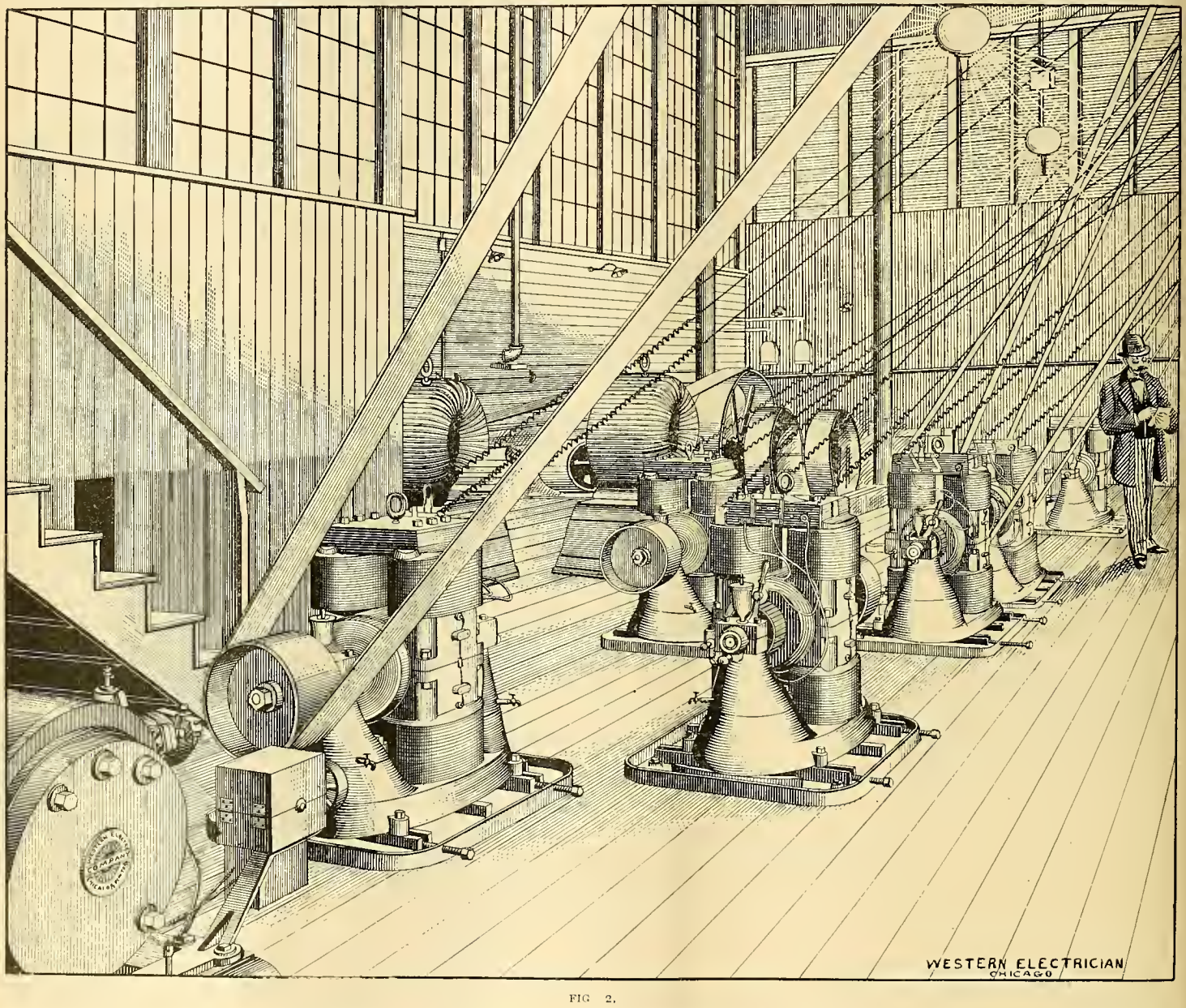


FIG 2.

las, gracefully weaving their sinuous way over the placid water. Rustic bridges and huge clumps of foliage add their influence to render the illusion more perfect. This view was taken from the center of a high bridge and brings out the lights suspended in the center of the arch over the water through the length of the building.

In Pioneer hall are located two more service plants, those of the Queen City Electric company of Cincinnati, and the Edison company. The former consists of two 500-light dynamos, run by a Ball engine, cylinder 13x12 inches; speed, 300 revolutions; rated at 100 horse power at 80 pounds steam pressure. This plant is used to furnish current to the colored lights in the Music hall, which very justly is the pride of all Cincinnati. It is a most noble auditorium and the colored lights drooping in colossal festoons give it a rarely beautiful aspect, most difficult to paint in words. The colored lamps are of the manufacture of the Sawyer-Man company, and are in reality colored lamps and not dyed with aniline dyes. The whol plant is most satisfactory, although it may be said here that the dynamos were put together at the place they have run for so many weeks and did not have a current through them until they were put in actual service. The lamps used about the plant are 16, 50, 75 and 150 candle power.

Adjoining this plant is that of the Edison company, consisting of four dynamos, each of 500-light capacity. These dynamos are driven by a 250 horse power Hamilton-Corliss engine, which is also utilized to drive a line shaft in Pioneer hall. Two Heine safety boilers of 250 horse power each, supply steam for the Hamilton-Corliss and the Ball engines.

All the wire used in the circuits of the service plants is underwriters' except in places where there is moisture and here okonite has been used. In the Edison circuits to the decorative displays Clark wire is used. In the service circuits there are about 3,200 feet of number 0000 wire; 7,000 feet of number 00; over six miles of number 6; 5,000 feet of number 10; 2,000 feet of number 12; 35,000 feet of number 14 wire, and about 3,000 feet of cotton insulated cord.

The gas used during the time the exposition is open was contracted for at $25,000, and the estimate in the cost of the electric lighting service plants was $20,000, while the decorative work was contracted for at $20,000. Aside from the service plants and the novel electric light effects, there are a number of exhibits very attractive to the visitor.

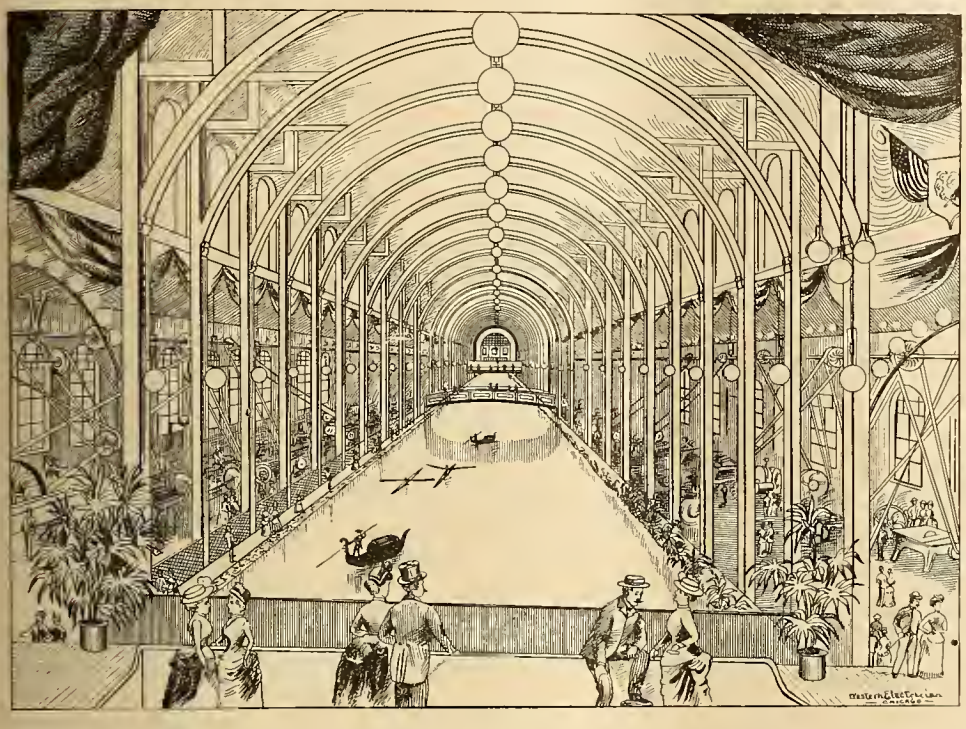


FIG. 3.

The Geo. T. Smith Middlings Purifier company, of Jackson, Mich., displayed a modern roller flour mill in full operation. It was lighted throughout by incandescent lights supplied with current from an Indianapolis Jenney 80-light dynamo.

The Poland Electric company of Cincinnati, displayed in Machinery hall two dynamos which were driven by a small high-speed engine.

The Queen City Electric company exhibited a 25 horse power motor, running a line shaft to which machinery was connected. The same company also had a generator of 50 horse power in operation, which was driven from a main shaft. The exhibit of the motors of this company was really not to be found in one place for they were distributed in many different places in the exposition, furnishing from a small fraction of horse power up to as high as 25 horse power, as stated.

The Spangenberg Electric company, also of Cincinnati, showed a new incandescent dynamo which furnished current for 75 incandescent lights.

The Geo. F. Card Manufacturing company of Cincinnati, had in Machinery hall a very fine display of motors driving fans, running sewing machines, driving a dynamo which furnished lights for the booth in which the display was made. The generator of current for the motor was a Waterhouse dynamo. The same company also had a large number of small motors distributed throughout the exposition.

The stamp envelope machine in the government exhibit at the Cincinnati exposition was run by a Mather 2 horse power motor.

A Queen City motor was employed to run the machines of the White Sewing Machine company.

Non-magnetic watches were found running a C. & C. motor, with, of course, the constancy of movement for which they are justly celebrated.

The Western Electric company, of Chicago, and the Standard Electrical works, of Cincinnati, had a booth in the Park building in which a very full line of electrical supplies were displayed. The exhibit was very handsomely arranged, and proved very attractive. A two-light arc dynamo was one of the beauties of the exhibit.

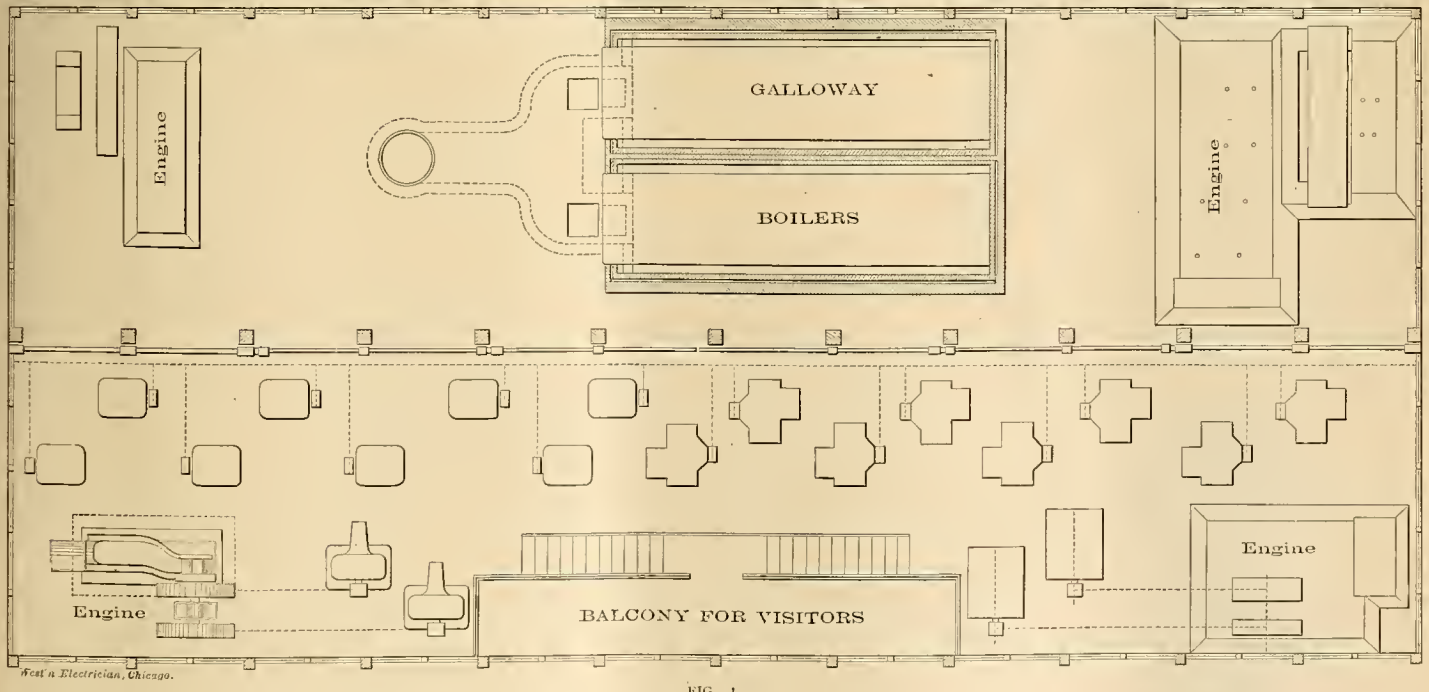


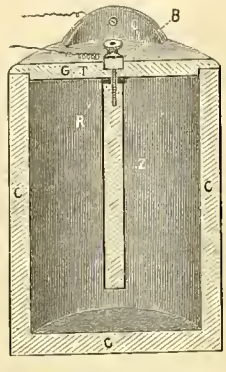
FIG. 4.

Out of 960 Sawyer-Man lamps in Music hall, 7 only burned out from July 4th to October 9th.

C. E. Jones & Bro., of Cincinnati, had a two-horse power Mather motor running an 18-light incandescent dynamo of the style illustrated in the last number of the WESTERN ELECTRICIAN. Their display of electric gongs, clocks, annunciators, pushes, electric bells, and in fact, a full line of supplies, was highly creditable.

A Carbon-Containing Cell.

A novel galvanic cell is that designed by E. S. Hotchkiss of Chicago, and illustrated by the accompanying engraving. In place of a glass cell containing the elements the cell is made of carbon, and of itself forms one pole of the cell. The construction will be better understood by noting the reference letters: The engraving shows a vertical section through the center of



the cell; *C*, represents the carbon; *G T*, the glass top; *Z*, the zinc rod; *R*, a rubber washer between the rod and the glass top; *B*, the binding post leading to the zinc rod, and at the rear of the top of the cell is another letter *C*, showing how the external wire is connected to the carbon element. Just below binding post, *B*, is seen a square nut. This nut is made a part of the screw which connects with the zinc rod, and it fits into a countersink in the glass top. The zinc rod can therefore be screwed up tightly against the rubber washer, and the binding post, *B*, can be screwed down tightly without moving the zinc rod.

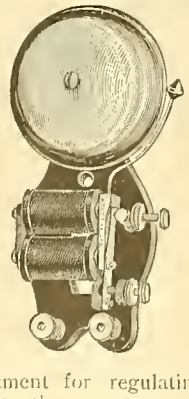
The novelty of this cell lies more in the processes to which it is treated than in newness, so to speak, of construction, for carbon-containing cells have been made heretofore, althongh they are not used to any extent in America at the present time.

The carbon jar or cell is seven-sixteenths of an inch thick. The outside receives a treatment of paraffine nnder pressure, so directed that the paraffine is incorporated with the carbon of the jar to a distance of about half the thickness of the carbon, and no further. The design of this treatment is to prevent the solution from finding its way outward through the pores of the jar. The interior snrface of the carbon subject to the action of the exciting solution is not treated, but is left in its natural state. That portion of the interior of the jar above the solution surface is dipped in paraffine to prevent the salts from creeping upward.

The battery is being made by the "H" Battery company of Chicago.

The Keating & Roxburgh Electric Bell.

Another new electric bell is that of Keating & Roxburgh, Corry, Pa., shown by the accompanying cut. The chief feature of this bell lies



in the adjustment for regulating the spring which supports the armature. By the simple turn of a screw the strength of the spring is made to conform to the strength of the battery current. The bell is supplied in either bracket or box form. It is nickel-plated, and the whole put together in the most workmanlike manner.

Bell Hangers' Hand-Book.[1]

By F. B. Badt.

PART III.

CONNECTING BATTERIES.

Chapter XXIV.

Connecting Batteries.

When several cells are joined together the whole arrangement is called a battery, though this term is very often applied to single cells also.

The conventional sign jar, a voltaic cell, consists of two concentric circles. The larger circle stands for the positive pole, the smaller jar the negative or zinc pole. There is another method of depicting the battery in diagrams. This consists of a series of short, heavy perpendicular lines alternating with longer light lines. The long light line represents the positive pole of the battery and the short heavy line the negative pole of the battery,

Cells may be connected in various ways:

Chapter XXV.

Cells Connected in Series.

Fig 19 represents four cells connected in series, or, as the arrangement is sometimes termed, in tandem for tension or pressure of current. If the electromotive force—e. m. f.—of one cell is 1.6 volts and the internal resistance of

FIG. 19.

one cell is 2 ohms, the whole battery would have an e. m. f. of $1.6 \times 4 = 6.4$ volts and an internal resistance of $2 \times 4 = 8$ ohms.

If we close the external circuit of a single cell and assume the external resistance to be practically nothing, the current strength through this circuit would be according to Ohm's law:

$$C = \frac{E}{R} = \frac{1.6}{2} = \frac{8}{10} = .8 \text{ amperes.}$$

In the case of four cells joined in series this equation becomes:

$$C = \frac{E}{R} = \frac{6.4}{8} = \frac{8}{10} = .8 \text{ amperes.}$$

Hence, we see that in joining cells in series we increase only the e. m. f. and the total internal resistance while the current strength remains the same.

In connecting cells in series the positive pole of the first cell is always connected to the negative pole of the second, the positive pole of the second to the negative pole of the third, and so on, as Fig. 19 shows.

Chapter XXVI.

Cells Connected in Multiple Arc.

Fig. 20 represents the same four cells connected in multiple arc, also termed, in parallel, for quantity of current.

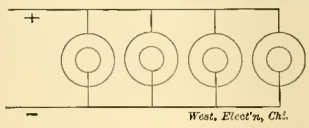


FIG. 20.

The e. m. f. of this battery of course is the same as that of one cell, namely, 1.6 volts, while the total resistance is

$$\frac{2}{4} = \frac{1}{2} = .5 \text{ ohms}$$

Regarding the external resistance as practically nothing, the current strength is:

$$C = \frac{E}{R} = \frac{1.6}{.5} = 3\tfrac{1}{5} = 3.2 \text{ amperes.}$$

We see that by joining cells in multiple the e. m. f. remains the same while the current strength increases and the internal resistance decreases.

The internal resistance of a cell is largely dependent upon its size; thus, by increasing the size of a cell and its plates the internal resistance is decreased, and the current strength through a given external resistance is increased.

The e. m. f. of a cell of course does not depend upon its size; it depends simply upon the choice of metals and fluids which are used in the cell. A cell of the size of a thimble constructed out of the same metals and put together in the same way as a cell the size of a barrel, would have the same e. m. f. The internal resistance, however, in the larger cell would be greatly reduced.

In connecting cells in multiple arc all the positive poles of the cells are joined in one pole, and all the negative poles in one pole as shown in Fig. 20.

Chapter XXVII.

Cells Connected in Multiple Series.

Fig. 21 represents the same four cells connected in multiple series, that is to say, in a combination between series and multiple arc.

There are, in fact, two batteries, each consisting of two cells joined in series, and then considering each of these batteries as one cell, they are connected in multiple arc.

The e. m. f. of each two cells in series is $1.6 \times 2 = 3.2$ volts, hence the e. m. f. between the poles of the battery is the same.

The internal resistance of each two cells in series is $2 \times 2 = 4$ ohms; hence, the internal resistance of the whole battery is $\frac{4}{2} = 2$ ohms, or the internal resistance of the whole

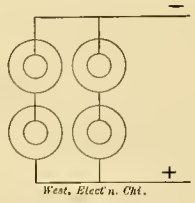


FIG. 2 .

battery is equal to that of a single cell. According to Ohm's law

$$C = \frac{E}{R} = \frac{3.2}{2} = 1.6 \text{ amperes.}$$

Chapter XXVIII.

Recapitulation.

Four cells each of 1.6 volts e. m. f. and 2 ohms internal resistance connected in the various ways described in Chapters xxv, xxvi and xxvii, will have the features shown in the following table:

Whole Battery. SERIES.	MULTIPLE ARC.	MULTIPLE SERIES.
Total e. m. f. in volts.....6.4	1.6	3.2
Total internal resistance in ohms..... 8	.5	4
Total current strength in amperes..... .8	3.2	1.6

This table shows very clearly the different results that may be obtained from the same four cells when differently connected up.

Chapter XXIX.

Work.

The work accomplished by electricity is expressed in volt-amperes or watts. If we multiply the number of amperes by the number of volts, we get the number of watts or the amount of electrical energy developed. If this be true we must, of course, in the foregoing examples get the same amount of energy in every case.

1. Series: 6.4 volts × .8 amperes = 5.12 watts.
2. Multiple arc: 1.6 volts × 3.2 amperes = 5.12 watts.
3. Multiple series: 3.2 volts × 1.6 amperes = 5.12 watts.

Hence, we see that the same amount of work can be done with great current strength and low e. m. f. or with small current strength and high e. m. f.

Chapter XXX.

External Resistance.

In the foregoing we have considered in our calculations only the *internal* resistance of the battery. In practice, however, we must consider the *external* resistance also This external resistance is offered to the passage of the current by the wires and the apparatus that is to be operated, as, for instance, an electric bell.

Suppose the total resistance of the external circuit is 8 ohms. To calculate the current strength we again use the equation of $C = \frac{E}{R}$ but the R in the calculations made in foregoing chapters represented only the *internal* resistance of the battery, while now we must change the equation so as to make it include the *external* resistance also.

We now write the equation

$$C = \frac{E}{R + r},$$

C standing for current strength, E for electromotive force, R for internal resistance and r for external resistance. By using the foregoing equation the table in Chapter XXVII, giving the data for four cells, now appears as follows:

Whole Battery.	SERIES.	MULTIPLE ARC.	MULTIPLE SERIES.
Total e. m. f. in Volts.	6.4	1.6	3.2
Total *Internal* Resistance in Ohms.....	8 } 16	.5 } 8.5	4 } 12
Total *External* Resistance in Ohms.....	8 }	8. }	8 }
Current Strength in Amperes.....	.4	.19	.26

We see from the table that we get the greatest current strength by connecting the cells in series, and the least current strength by connecting them in multiple arc.

Chapter XXXI.

Rules for Connecting Batteries.

As a general rule it may be set down that the *greatest power* of a battery will be obtained if the cells are connected in such manner that *the internal resistance R becomes equal to the external resistance r.* In some cases this will not be possible, and a combination must be chosen which will come nearest to these conditions.

Generally it will be necessary to connect the cells in *series* when the external resistance is very *great*, and in *multiple arc* when the external resistance is *small.*

Batteries of different constructions should never be connected in multiple arc, as the e. m. f. might differ, and even with an open circuit, currents would be generated.

Rule: If the total internal resistance of a battery, with all the cells connected in series, should be greater than the external resistance the best combination is formed in the following manner:

Multiply the number of the cells by the external resist-

[1] Bell Hangers' Hand-Book, by F. B. Badt, author of Dynamo Tenders' Hand Book; in course of preparation; about 100 pages, 80 illustrations; flexible cloth binding; type page 6 inches by 3 inches; price $1. All rights reserved.

ance; divide by the resistance of a single cell, and take the square root of this quotient. This will give the number of the cells which must be connected in series.

Example: Twenty cells are to be connected. The internal resistance of one cell=5 ohms; the external resistance =25 ohms.

$$\frac{\sqrt{20 \times 25}}{5} = \sqrt{100} = 10$$

Hence two batteries, each of 10 cells in series, must be connected in multiple arc.

The resistance of 10 cells in series in this case is $10 \times 5 = 50$ ohms. The resistance of two such batteries in multiple arc of course is $\frac{50}{2} = 25$ ohms. Hence we see that the internal resistance of the battery is equal to the external resistance, which, as stated, is the best relation for working.

BATTERY DATA.

CHAPTER XXXII.

Data Regarding Batteries.

The following table gives the necessary electrical data of batteries. From these data all necessary calculations can be easily made:

E. M. F. AND RESISTANCE OF VARIOUS CELLS.

Name of Cell.	Metal Negative Pole.	Exciting Fluid on Negative Pole.	Depolarizing Material on Positive Pole.	Metal Positive Pole.	E. M. F. in Volts.	Resistance in Ohms.
1. Smee	Zinc	Sulphuric acid 1 part, water 7 parts.	Electropoion.	Platinized silver	.70	.5
2. Gronet	Zinc amalgam.	"	"	Carbon	1.80	1 quart bottle.
			POROUS CELL.			
3. Daniell	"	Sulphuric acid 1 to 7	Copper sulphate	Copper	1.07	2.8
4. Grove	"	" 1 to 20.	Fuming nitric acid	Platinum	1.96	Med'm size
5. Bunsen	"	"	"	Carbon	1.80	.2
6. Carbon	"	"	"	"	1.80	(?)
7. Nickel plating	"	"	Electropoion	"	1.80	(?)
8. Fuller	"	Mercury and water	Bichromate of potash & sulphuric acid, 1 to 1.	"	1.75	(?)
9. Leclanche	"	Sal-ammoniac	Binoxide of manganese.	"	1.40	5
Disque					1.40	1.2
Prism					1.40	4
10. Diamond carbon	"	"	Large surface	"	1.00	5 to 20
11. Gravity	Zinc	Sulphate of zinc	Copper sulphate	Copper	1.44	.32
12. Gassner (dry)	"	(?)	(?)	"		

These figures are only approximate, especially those relating to internal resistance, which varies greatly with the degree of the saturation of the liquids, the surface of the plates, their distance, etc., but in any case they serve as a guide.

The e. m. f. of the Daniell cell equals about 1 volt, which is the unit of e. m. f.

The current strengths required vary greatly according to the nature of the appliances. Electric vibrating bells, for instance, require about .2 amperes. They act very well with two Leclanche cells in series. Regarding the resistance of one prism cell as 1.2 ohm; the e. m. f. of one Prism cell as 1.40 volts; the resistance of bell as 8 ohms, and resistance of wire as 2 ohms; then

$$C = \frac{E}{R+r} = \frac{2 \times 1.40}{1.2 \times 2 + 10} = \frac{2.80}{12.40} = .23.$$ or about ¼ ampere.

Polarization, bad contacts and leakage in line may reduce this to about ⅛ ampere. Currents used in telegraphy are very often not greater than about $\frac{1}{100}$ ampere. In order to get good results, it is therefore necessary to know first the resistance of an instrument and the current strength necessary to operate it; then the combination of the battery and the number of cells can be very easily determined.

Very often cells are guaranteed to last a certain length of time. This, of course, is pure nonsense. For instance, it is clear that every time the circuit for an electric bell is closed, a certain amount of energy is wasted in the cell, supposing 50 calls a day are made on the cell, and it would last, say one year; with 100 calls a day it would last only half a year, and with 200 calls a day only one-fourth year.

If the wires are badly insulated, so that leakage ensues, the battery may be slowly exhausted without doing much useful work, and thus cause an early breakdown of the battery. This will explain why the same battery may apparently give excellent service in one case, and behave very poorly in another.

CHAPTER XXXIII.

Divided Circuits.

If a circuit divides, as in Fig. 22, into two branches at A, uniting again at B, the current will also be divided, part flowing through one branch and part through the other.

The relative strength of current in the two branches will be proportional to their conductivities.

In fact, this law will hold good for any number of branch resistances connected between A and B. Conductivity is the reciprocal of resistance. If, for instance, we assume that the resistance of $r = 10$ ohms and $r_1 = 20$ ohms, the current through r will be to the current through r_1 as $\frac{1}{10}$ to $\frac{1}{20}$. This may be written in the form of a proportion:

$$\frac{1}{10} : \frac{1}{20} = \frac{2}{20} : \frac{1}{20}$$

or as 2 : 1,

or, in other words, $\frac{2}{3}$ of the total current will pass through r and $\frac{1}{3}$ through r_1. The *joint resistance* of the two branches between A and B will be *less* than the resistance of either branch singly, because the current has increased facilities for travel. In fact, the joint conductivity will be the sum of the two separate conductivities. Taking again the resistance of $r = 10$ ohms and $r_1 = 20$ ohms, we have the joint conductivity $\frac{1}{10} + \frac{1}{20} = \frac{3}{20}$, and taking the reciprocal of $\frac{3}{20}$ we get $\frac{20}{3} = 6\frac{2}{3}$ ohms as the joint resistance. In most of the cases we have to deal with in this treatise the resistances of the different branches will be alike; this simplifies the calculations considerably. Take, for instance, two branches of 10 ohms resistance each and find the joint resistance:

Demonstration:

$\frac{1}{10} + \frac{1}{10} = \frac{2}{10}$; the reciprocal is $\frac{10}{2} = 5$ ohms,

or, in words, the joint resistance is one-half of the resistance of one single branch, and each branch, of course, will carry one-half of the total current in amperes.

With 3 branches of equal resistance the joint resistance will be ⅓; with 4 branches ¼; with 100 branches $\frac{1}{100}$ of the resistance of one single branch.

If the resistance of one electric instrument is 10 ohms, the joint resistance of 50 of these instruments connected in multiple arc is $\frac{10}{50} = \frac{1}{5}$ ohm; taking the current of the whole battery as 15 amperes, a current of $\frac{15}{50} = \frac{3}{10}$ amperes would pass through each instrument.

(To be continued.)

Electric Welding.

Before the American Society of Mechanical Engineers, in session at Scranton, Pa., October 18th, a paper on "Electric Welding" was presented by C. J. H. Woodbury of Boston, Mass. After referring to the importance this method of welding has already assumed and its possibilities, the speaker laid down the principles underlying the application of electricity to this purpose and described the apparatus. With this paper was submitted the results of a series of tests made at the United States arsenal, Watertown, Mass. Tests were made on wrought iron, octagonal steel, steel and wrought iron, copper, brass, brass and wrought iron, and steel and German silver, bars, and showed most satisfactory welds.

DISCUSSION.

In answer to a question by Mr. Kent, as to how the two ends of a ring could be welded by electricity, Mr. Kent thinking the current would go around through the complete part instead of jumping the joint:

MR. WOODBURY: As I said in the paper the resistance of a conductor is inversely as the length, other things being equal. When a bar is bent to the form of a circle or other closed curve, the clamps hold the ring near the juncture and there will be a small distance between them. That distance may be $\frac{1}{20}$ of the circumference of the circle and, say $\frac{19}{20}$ of the electricity will pass from one side to the other through the point of juncture, and only $\frac{1}{20}$ of it will go through the longer side. As I stated in the course of the paper, the heating effect is proportional to the square of the current and other conditions, and therefore the union between the joined ends of the rod will be heated to a welding point, while the rest of the loop will not be appreciably warmed. I have in my hand a small ring $\frac{6}{8}$ of an inch in diameter welded by electricity, and you see a number of them of various sizes among the examples of welding. It is in practical use for much larger work however; spinning rings and carriage tires are joined by this process.

OBERLIN SMITH: I visited the laboratory of the Thomson-Houston Welding company a few weeks ago, and I saw several very interesting experiments tried, and among others, which I tried myself, was the welding or soldering together of two pieces of ordinary tin plate, each piece perhaps the size of half a dollar. They seemed to join perfectly and made an excellent flat joint.

I saw another very interesting thing where a steel die, an inch long, was put between the copper poles of the machine which were, I think, an inch and a half in diameter. That part [indicating] was brought to a bright red, spreading out very little further than the edge of the copper pole clear through, the other remaining perfectly black for several seconds; showing that by having a pole here, nothing but a chunk of copper flat on the end, of that size, pressed up against it, the whole die could be heated any color desired right through, on those jaws alone, all the rest remaining cold. It occurred to me if I had only known that ten years ago, it might have been a perfect solution of the tempering process.

Ralph W. Pope was called upon by the chairman.

RALPH W. POPE: Some of the points which I wish to discuss have already been touched upon; but there have been various questions and surmises in regard to the perfection of the electric welding process, and I heard from one mechanic who has a very high reputation, that he thought that it burned the metal. I wish to say in regard to this that we should not confound this process in any respect with the arc light, which, as we all know, fuses metals. The conditions are entirely different.

In regard to the burning of the metal, if I may be permitted, I will read a letter from Prof. Dolbear which I came across to-day, and which is quite interesting and goes to confirm the tests that have been made later.

"*Sir:* I have made nearly a hundred tests of the tensile strength of electrically welded bars of iron, steel and other metals. The results were of such a character that I can state positively that with Thomson's welding process it is possible to weld both wrought iron and steel so that the weld is as strong as the same cross section in another part of the bar; that the appearance of the fracture is fibrous for iron and generally granular for steel, the strength of this granular steel being in some samples as high as 125,000 pounds per square inch; that the process is such that the welding is homogeneous from necessity. I had a number of bars welded by an expert blacksmith, and a number of similar ones by the electrical process for comparison, with the result that the electrically welded bars were much stronger than those welded by the ordinary process. The bars were of various sizes, up to an inch and a half for iron and three-fourths of an inch octagon steel.

A. E. DOLBEAR."

Directly the electrical people have proposed only one use for this electric welding process, but that is very important. One of the weak points in electrical construction is bad joints; joints in the copper wire are twisted and soldered. The work is very often poorly done, and, as Mr. Woodbury will tell you, joints of that character are liable to cause fire and give a bad reputation to the electrical business. I might say right here that, although electricity is considered a mystery, we really understand its laws and what it will do, and how it will do it, although we know not exactly what it is, and, consequently, if everything is done well, if lines are properly constructed and the wires are properly insulated, there will be very little of this trouble that you hear about which comes from the cheap construction and the poor methods that are generally in use when an industry of the kind is first being developed.

JEROME WHEELOCK: I would like to join in the discussion to the extent of adding my testimony to the value of this process and to show what my experience has been in the matter of screws nine tenths of an inch in diameter and five feet and a half long, which are troublesome things to make and to repair when they become broken. It occurred to me that I would try the electrical process of welding. I sent a screw to the works and it came back the next morning perfection. The lead of the screw was perfect, without any change, and the strength of the screw at that point was beyond question as great as ever. With the many ways in which electrical welding can be made practical, it seems to me it should receive the encouragement of every mechanic.

OBERLIN SMITH: I think that any one who knows anything about ordinary blacksmithing, which probably that critic who spoke about burning up steel might not have done, would have no fear of steel being burned by this process any more than in a blacksmith's fire, and not as much. There is nothing mysterious about the action of electricity on the metal. It simply heats it. That heat is under perfect control. There are no impurities coming up out of the fire—sulphur or smoke—to damage the steel; no danger of the fire getting ahead of you; no danger of heating the bottom of the bar while the top remains cool. Of course we have to heat steel up to a certain definite degree, to weld it in any shape to its melting point, and as this process does it more uniformly, neatly and under much better control and with a great deal more cleanliness than a blacksmith's fire can do it, there cannot possibly be as much danger of burning steel here as there is in that case. It can be protected by plugs and in other ways, if necessary. All there is to do to it is to bring it up barely to the melting point, and press it together, so that it is impossible that that objection should have any force.

MR. WOODBURY: The question was asked relative to the enlargement of the joints at the portion of the weld. One difficulty with ordinary hand butt welding has been the reduction of the cross section by the process Here the cross section is somewhat enlarged, and that has not been considered a defect in chains; on the contrary, it has a tendency to prevent a chain from kinking. In some of the special forms of this welding apparatus there are a pair of swages that strike a blow on the metal as soon as the weld is effected, for the purpose of reducing both surfaces to a smooth point; as, for example, in the joining of old cotton bale ties, the operator by placing his foot upon a treadle strikes a blow upon the weld and reduces it to uniform section. There is an addition to the process of chain manufacture to which I have not alluded, because it has not yet been developed to a commercial basis, and that is the method of making an electric welded chain by machinery, passing the rods into the machine where they are cut, bent and joined, then welding the chain in a thorough manner and passing it out at the other end of the device.

The Westinghouse Company's New Catalogue.

The Westinghouse company's new catalogue, treating of its alternating system of electric lighting, is naturally a compendium of information regarding the system and its details, but the text will not receive consideration from any recipient of the catalogue until the sense of appreciation of the artistic effects has been satisfied. This catalogue is an exponent of the possibilities of the "art preservative." It is 19 inches wide by 12 inches long—a truly colossal scale for a book of this class. The conception was grand, and the execution has fulfilled the conception. The front cover of a dull bronze bears in embossed letters the name of the company, and the back cover an artistic design also embossed. The title page, a unique design showing the name of the company, its officers, the title of the book and a view of the Pittsburgh factory, is printed in three colors. The fifth page on which the first of the letter press appears shows an odd conceit of a fairy seated on a toadstool holding aloft an incandescent light for the emulation of the will-o'-the-wisps. Throughout the book bits of artistic handiwork are thrown in to illumine the text. The illustrations are made on wood and in the style in which the WESTERN ELECTRICIAN is a firm believer, that is, the very best obtainable. The text itself as far as description goes is complete, but at the same time it exemplifies the capabilities of the printer's fonts. The typographical and press work are in keeping with the rest of the work, and the whole forms a splendid tribute to the magnitude of the company who conceived it.

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CONTENTS OF THIS NUMBER.

PAGE

The Cincinnati Exposition, Illustrated..... 215, 216, 217
A Carbon Containing Cell, Illustrated 218
The Keating & Roxburgh Electric Bell, Illustrated. 218
Bell Hangers' Hand-Book, by F. B. Badt, Illustrated, Part III.:
Connecting Batteries 218, 219
Battery Data..... 219
The Westinghouse Company's New Catalogue..... 219
Electric Welding..... 219
Editorial..... 220
American Street Railway Association..... 221
The Solution of the Municipal Rapid Transit Problem, by Frank J. Sprague, Part V, Concluded:
F. J. Sprague's Reply..... 222, 223
Electricity as Applied to Sea Coast Defences..... 223, 224
New York Board of Electrical Control 224
Lamp Lighting Schedule –Moonlight System..... 224
Thomson-Houston Boston Offices 224

DEPARTMENTS.

Correspondence 224, 225, 226
The Electric Light 226, 227
The Electric Motor..... 227
The Telephone..... 227
The Telegraph 227
Electrical Patents 228

THE latest report in reference to the copper syndicate is that contracts have been renewed with the owners of mines for a period of twelve years.

THE New York letter is of unusual interest this week, containing as it does the details of the acquisition of the Westinghouse company in the metropolis.

THE subject of seacoast defences is timely. The discussion of the fisheries question has led to a belief that war in this country is possible, though not probable. The "unprotected seacoast" is a favorite topic in many an eastern paper. Captain Zalinski in a lecture before the New York Electric club last week showed the importance of electricity as applied to seacoast defences. He was prevented from divulging much of the progress recently made in this field, but the abstract of his lecture shows that much has been accomplished. He urged electricians to turn their energies in this direction.

As there has been a misunderstanding in reference to the action of the Chicago city council on the telephone question, it should be stated that the ordinance which has been adopted is not a penal measure. In this respect it differs from the measures in force in Indiana and in St. Louis. The telephone company has not yet accepted the ordinance, and it is generally believed that it will not be accepted, at least in its present form.

A short time ago a petition was circulated among merchants asking for a reduction of telephone rates. They were also asked to add their names to an agreement to pay $5 or $10 in case the city council made the desired reduction. It was intimated by the daily press that several aldermen were likely to share in the profits of this collection, although a firm of lawyers admitted that they had circulated the petition and the agreement. At the meeting of the city council last Monday evening a resolution was adopted instructing the law department to investigate the matter.

ANOTHER installment of the report of the last meeting of the Institute of Electrical Engineers is given in this issue. The discussion which has followed Mr. Sprague's paper has been unusually interesting and instructive. This week is given Mr. Sprague's reply to those who have criticised him. He laid stress on the fact that the system which bears his name had been materially improved since the construction of the Richmond road. The experience which had been gained by the building of that road, he considered one of the most important consequences of the installation. Mr. Sprague's remarks were entirely practical and the relation of his methods of solving the unlooked-for problems which constantly beset him is full of interest.

OVER 5,000 incandescent lamps, 420 arc lamps and 17,000 gas lamps furnish the illumination of the Cincinnati exposition. Twelve men, including electricians, dynamo tenders and linemen, attend to the electrical plants, while forty men are required to clean and light the gas lamps. Lamps of the latter class exposed to the weather cannot be lighted evenings when it is rainy, while the electric lights furnish illumination irrespective of weather. The gas lamps would have been supplanted by electric lamps but for the fact that the managers of the exposition did not have sufficient boiler capacity, and could not obtain it without going to an unusual expense, such as erecting a new building. The advantages of the electric light were never more clearly demonstrated.

THE London *Electrical Review* is irritated by the suggestion of the British association committee on nomenclature that the electrical vocabulary be enriched by the coinage of the terms "kine," "bole" and "barad." It says: "We are inclined when we meet such suggestions to ask when this insane craze for new terms is likely to cease, or whether the British association is ever likely to become sensible. In what respect is the expression 'a velocity of one kine' better than 'a velocity of one centimeter per second;' or the phrase 'a force of one barad' superior to 'a force of one dyne per centimeter.' It is absolutely certain that the latter is more expressive than the former, while its use involves no effort of memory to realize the meaning conveyed. If these terms are adopted, we may look for other suggestions at future meetings. Engineers will learn how utterly lost they have been in speaking of a force of 'one pound per square inch,' and will in future talk of a force of a *Bram*, named after the president. They will cease to compute velocities in 'feet per minute,' and talk instead of a velocity of so many *Preeces*, in honor of the president of section G. To the electricians might be given *Fitz*, as the expression for one C. G. S. line of force per square centimeter. This would be named after the president of section A, and thereafter we would speak of a field of 20,000 *Fitz*."

JUDGE BLODGETT of Chicago has an interesting point of law under advisement. It is one growing out of the Central Union Telephone company's withdrawal from the telephone business in the state of Indiana, for the reason that the rates fixed by enactment were too low to afford any margin for profit. The point has come up in a suit by the Bell company for an injunction against the Cushman company, restraining it from establishing and maintaining telephone exchanges in Indiana. The contention of the defendant is that it would be decidedly impolitic to withdraw from the public any useful invention or art, and make of it a subject of private monopoly. Authority was quoted to the effect that the temporary monopoly granted to inventors was never designed for their exclusive profit or advantage. The primary object in granting patents was to benefit the public and not the individual, and that which is once given to or invested in the public, cannot be taken away from them. The people of Indiana had invested in them a certain system. That system, said the counsel for the Cushman company, they are entitled to, and the Bell company had no right to take it away from them.

Defendant's counsel declared that the telephone service had become interwoven into the commerce of the country, and that it is not for the owner of the patent to say he can give it or not to the public at his own price, and upon his own terms.

TO YOUNG readers or those whose opportunities for education in mathematics have been limited, the installment of BELL HANGERS' HAND BOOK in this issue may seem abstruse, but a careful perusal and study of the equations and formulæ will quickly develop the fact that they are not nearly as difficult as they appear. "The statement of a fact clarifies it," is an apt quotation in Dr. Moses' recent address before the Cincinnati Electrical society, and has an application to the matter in question. Readers not familiar with mathematical formulæ should write those laid before them in this issue and carry out the processes indicated until the results given are obtained. This will virtually be a statement of fact and it will be of material assistance in making the equations clear.

THE consideration of electric motors for street car propulsion occupied considerable time at the annual meeting of the American Street Railroad association, in Washington. A report will be found elsewhere in this issue. The subject is one of the greatest interest to both street car companies and to electrical corporations; to the former because electricity is to be the future motive power for the street cars, and to the latter because a new field is being rapidly opened for them. The merits of all the prominent systems were presented and discussed. Mr. Sprague presented the claims of his system. William Bracken discussed the merits of the storage battery. G. W. Mansfield explained at considerable length the details of the Thomson-Houston system, and the claims of the Bentley-Knight system were explained by Robert W. Blackwell. The West End road at Boston was referred to as a particularly interesting piece of work, as it will be operated by the conduit and overhead systems. The operation of several new roads at the north, during the cold months when new difficulties will present themselves, will be watched with interest by both electricians and street car men. Mr. Sprague disposed of the subject of lightning in this summary way: "I would run a car in the heaviest thunderstorm in the United States, and feel perfectly safe."

ELECTRIC WELDING is a subject of prime importance to all the manufacturing industries making use of metals, and consequently, there was a place in the proceedings of the American Society of Mechanical Engineers at Scranton, Pa., last week, for a paper on electric welding, by C. J. H. Woodbury of Boston, Mass. The principles underlying the application of electricity to this purpose and one of Professor Thomson's machines have been treated at length heretofore in the columns of the WESTERN ELECTRICIAN. The discussion reinforced points regarding the perfect adaptability of the electric current to the purpose of welding in the application of heat at the point desired; in the perfect control of the heat, and in the purity, so to speak, of the heat, that is, a heat free from the impurities of a coal fire. Professor Dolbear's straightforward and thorough indorsement of the electric welding process is borne out by the series of tests referred to in the opening paragraph of the brief article devoted to the subject.

As time progresses, and new applications of the electric welding process are discovered, the conviction that it is bound to revolutionize mechanical methods becomes more deeply impressed. The members of the American Society of Mechanical Engineers will find in the report of the proceedings of that body no pages of more vital interest than those devoted to the subject of electric welding.

American Street Railway Association.

The seventh annual meeting of the American Street Railway association was held in Washington, D C., October 17th. Mr Richards, who had been announced to read a paper on the progress of electric motive power, was not present, and President Holmes announced that the convention would have to depend upon those present for a discussion of the matter.

Wm Bracken of Philadelphia, representing the Julien Electrical company of New York, was the first speaker:

"I am not here to discuss the relative merits of overhead systems and conduits, but the storage battery traction About two and one-half years ago " said the speaker, "I was in the city of Brussels, and on leaving my hotel one morning saw a car moving along without horses or visible means of propulsion. I boarded it, and upon inquiry found that it was run by accumulators. We made arrangements with Mr. Julien to forward us a car to New York, so as to apply electric traction here as well as in Europe The car sent us was ill adapted for America, but the methods of producing storage batteries two years ago proved to be very crude Mr. Julien sent the most improved machinery and an electrician. We went to work, and fortunately, were able to secure the services of keen, bright American mechanics and chemists, and we soon discovered the crudeness of the work as done in Europe. We are prepared to equip a street railway line for less than it costs for horses By the improvements made by H. G. Morris, a well-known mechanic of Philadelphia, we are able to do the work with two girls that it takes fifty men to accomplish in Brusse's. The great trouble experienced with applying electricity as a motive power has been in securing men competent to handle the apparatus. It is comparatively easy to secure men for cable roads, but as we are engaged in a comparatively unknown art, of course it is difficult at first to find competent men, but we have made such advancement that our shop at Camden, N. J., is 2,500 cells behind its orders. We light a large number of the Pullman cars, the vestibule cars on the Pennsylvania road, and the entire works at Waltham, Mass. All these are run by the Julien storage battery. This shows the progress in two years made in this comparatively unknown art: We put a car on the Fourth and Madison Avenue line on the 17th of last month. This car has a body of eighteen feet and capacity of carrying seventy-five people. It has been running constantly since, and has not stopped traffic once, or experienced an accident of any kind."

Thomas C. Barr of Philadelphia, president of the People's Passenger Railway company and the Lombard & South Street Passenger Railway company, said: "The storage battery system was tried experimentally over our road for at least two months, running sixteen miles a day with 22-feet cars, the aggregate weight being 14,800 pounds, of which 4,800 pounds was the weight of the batteries. These batteries were operated by the Electric Power company of America. The car would seat thirty four passengers and would carry, when crowded, 125 persons. When thus loaded the average weight would be 30,000 pounds. A two months' trial was very satisfactory, as the car ran smoothily, steadily and nicely. It moved off gently from a full stop without any jerk, and was taken off only by reason of the fact that a large sewer was constructed through the center of our street, causing us to run a siding, and we were afraid the weight of the car would interfere with the work.

"The only difficulty at present is the cost of equipping the cars with the storage batteries as well as the cost of reconstructing the road, but I have no doubt this system will in a very short time be brought down to such a point that the car can be operated by batteries much less in weight at a great saving of expense.

F. J. Sprague, of the Sprague Electric Railway & Motor company, stated that the conduit, overhead and storage systems all had their good points, and each had its way of working to attain the effect. On the second day of last February the Richmond road was started, and is the largest electric railway in the country, having twelve miles of tracks. It is operated by overhead wires. The grades on this road are from six to eight feet, and the curves from twenty-six to twenty-seven feet. Since starting the cars have run 500,000 miles, and 1,000,000 people have been carried. At times the cars have run 8,000 miles without going in the shed; in fact, they have been housed in the street under the canopy of heaven for some months. They were built for the work of 7½ horse power, but have frequently been compelled to do the work of 12 horse power. From 90 to 96 per cent. of the cars are in constant service, working twenty to twenty-one hours a day. A lighting company furnishes the power to the Richmond cars for $1.60 a day.

"In Harrisburg we had fifty cars running on a line constructed by our company.

"The central station of the road building in Boston is so constructed as to be able to take in all roads in the city. Three miles of this road will be built by the conduit system under the Bentley-Knight system. This winter will furnish the crucial test of electric roads in the Northern States. We will see what effect the hard winter weather will have on the roads. We have roads in Boston, Akron and Cleveland. Next spring it will be known what the electric roads are."

Mr Sprague was asked if his company owned any portion of these roads He said: "Not a cent. We have no interest in them, and don't want any. We employ the best men and hold them responsible for their work. I think we have harnessed lightning so as to avoid any trouble from that source. All that can be seen when lightning strikes a wire is a click and a spark; the passengers know nothing of it. Sometimes it may burn out the motor. I would run a car in the heaviest thunderstorm in the United States and feel safe from danger."

G. W. Mansfield of the Thomson-Houston company, said: "The successful application of electricity to the propulsion of street cars can only be attained by the most hearty co-operation of the electricians and the railway men. The electricians must look to the practical and experienced railway managers for a full and complete knowledge of the obstacles to be overcome, and the results necessary to be attained, and the business man must be informed fully and freely of the plans of the engineer and of the practical result of his study and research, that he may intelligently criticise, advise, correct, and, in the end, accept or reject.

"Being fully impressed with the truth of this statement, as I am called upon as a representative of the Thomson-Houston Electric company, I desire to explain some of the details of our apparatus, the reasons for adopting the various devices, and the practical results which we have achieved.

"We think that the truck should be entirely independent of the car body. The advantages of this arrangement are manifold. At the outset of our work we found that the approved system for placing motors under the car was to clasp the axle with one end of the motor and provide a flexible support from the car body for the other end. We were unable to give our approval to this method, and we designed a flexible support on the truck itself, which left the motor entirely independent of the oscillations of the car body, and still gave us the slight play necessary to lighten the strain in starting the car. All of our trucks have been constructed on this principle since our first car was started at Crescent Beach on the 4th of last July. We are pleased to observe that other electric companies have recently adopted this system, as it proves the correctness of our views.

"Our motors are provided with self-oiling bearings and self feeding brushes, so that they work automatically. The brushes are set at right angles to the face of the commutator, thus avoiding the troubles which arise with tangential brushes. The laminations of sheet copper which make up the brush are placed at right angles to the direction of rotation or edgewise, so that it is impossible for them to become bent. They wear very gradually and require no attention until they are actually worn out, when they can be very easily and quickly replaced. Our practical experience shows that no other form of brush will give such excellent results; we have had no trouble with brushes on any of our motors. Our motors are constructed with but one commutator, using but one pair of brushes, and this with our automatic feeding brush holder, greatly simplifies the mechanism and reduces the attention required, to a minimum. The electrical and mechanical proportions of our motors are such that no adjustment of the brushes is required for change of load, and sparking is entirely obviated.

"We have from the first, with perfect success, used fiber gearing to deaden the noise, and we are glad to see that other companies are now adopting this obvious means of accomplishing so desirable a result.

"The question of the use of an outside rheostat to control the current in stopping and starting the car, was one which received very careful consideration. Without going into the scientific points, we will simply say that we deemed the use of such rheostat much safer, more reliable, more economical as regards repairs, and in every respect preferable to the use of the field coils for a similar purpose. The rheostat is only used in stopping and starting the car; or say, for not over one-tenth of the time that the car is running; it is substantially constructed, and is very durable. The principal objection urged is that the bearing of the rheostat involves a loss or waste of power. This is true, but the waste is slight, whereas the use of field coils involves the danger of burning out of these coils, and a few such disasters would much more than counterbalance the slight waste of current in rheostat.

"In discussing our overhead system, I have arranged everything under three headings: Systems, methods and details.

"I divide systems into 1, one wire per track, using track for return; 2, two wires per track, one as the outgoing, the other as the return.

"Methods I divide into 1, bracket arm method, poles on side of street; 2, cross suspension method, poles on either side of street; 3, bracket arm method, poles in center of street.

"Details of methods I subdivide into 1, poles; 2, conductors or feeders; 3, supporting devices; 4, switch and curve devices.

"This arrangement is made to simplify, and to illustrate the fact that there are a great many things that we have to carefully consider. I shall not however, rigidly hold myself to the points in their chronological order

"In considering the systems, each has certain advantages. The one, however, possessing the majority will be the one most generally adopted. Taking experience as our teacher, we are taught that the single wire system is this one. A great deal, of course, depends upon local conditions, but so far we feel our opinion in this matter is correct.

"In either case the methods are almost identical, varying only by introducing the necessary insulation between the two wires My general remarks upon the methods employed, can therefore be applied to both systems. Obviously, the local conditions govern the question of methods. Am I to build a line for a road located upon the side of the street, or in the center; for a single track, or for a double track. Each of these we have already gone into extensively and carefully, and all can be seen practically worked out on the Eckington and Soldiers' Home railway in this city. In describing our details it might therefore be as well to briefly and accurately mention the details of this road. The poles on the portion of the line which runs through New York avenue, a very broad street, are located in the center between the tracks They are made of sections of iron piping varying from 6 inches to 3½ inches, and are rigidly connected together. Twenty-one feet from the ground cross arms are extended out to the center of the tracks. Every other pole is extended upward seven feet, from the top of which extension is placed a cluster of ten lights each of 32 candle power. Five of these are white and the remainder are red. The latter are automatically thrown in if one of these white lights should fail. The red is therefore an index to the line man that the cluster needs attention. The ornamentation of these poles is simple. Evidently the only limitation in this direction is the cost. We consider this method is to be more generally adopted if it is correct in principle, and the objections so generally raised are based upon some curious predilection or prejudice. The conductor is suspended.

"The posts used for the bracket method are of planed 9x9-inch tapered chestnut. The arm consists of a piece of 2-inch gas pipe, supported by a neat iron bracket bolted to the post. The posts used for the cross suspension method are of the same character, and as this method is so well understood I shall not enter upon it here. The conductor is supported with our regular cone insulators. These may vary somewhat, according to the conditions to be met. The cone insulator, as its name implies, is conical in shape. It is made of wood with a protecting hood of paper and canvas, preventing the same from getting wet, with resultant loss of current from leakage. It is provided with two hooks, one at the apex for hooking into the arm or cross wire, the other at the under side for hooking the ear to. The ear for straight work is soldered upon the upper side of the conductor, and then hooked on to the cone insulator. This leaves a perfectly smooth surface on the under side for the trolley wheels. For curve and switch work the ear is arched, so that the strains are all in the same place. This obviates all distortion and canting of the supports Insulation is also introduced on this ear directly at the point of support. The frogs for switches and turnouts are small, light, and absolute in their action.

"We ordinarily use a single conductor, stout and substantial in character, believing that some rigidity is advisable, and that a multiplicity of wires is objectionable, and to be avoided. Whenever the roads are of such magnitude that such a wire is not of sufficient capacity, we supplement it with feeders."

Robert W. Blackwell, representing the Bentley-Knight system, spoke as follows: "When I last had the pleasure of speaking to you at Philadelphia, last year, I said many things about what we proposed to do during the coming year. We have a road running on the conduit system at Allegheny City, Pa. Last December two cars were started, and February 15th four cars were running. About six weeks ago two additional cars were put on, making six in all. The work required of the motive power is the heaviest of the kind in the world. We are using the heaviest motors in the country, and have thirty nominal horse power on every car. The road has been swamped by freshets and bad other difficulties of like nature to contend with, but during the entire time there has never been a stoppage from a defect in the electrical system. The specialty of the Bentley-Knight system is the conduit system. We have laid the only conduit system. We build both overhead and underground roads, and have had to contend with every difficulty possible, and I think it is fair to say that we have met them all, and the road at Allegheny is a practical solution of the city railway service. We are now building a three mile section for the West End Street Railway company of Boston. The road is laid through some of the finest streets of the city, and upon this road both the conduit and overhead systems will receive a crucial test, and from the results of the trial the future of electrical motive power can be decided. Upon a thirty-day trial made by the superintendent of the Allegheny City road, the result was as follows: Daily mileage per car 72 miles, running on an average five cars per day. The receipts for the last four days were as follows: September 23, $201; September 24, $116; September 25, $151; September 26, $153. During the four days the average mileage per car per day was 8 miles per car During the coming winter a thorough test of the working of the conduit system will be made at Boston, New York and Allegheny, the difficulties being such as to meet the requirements of every road in the United States.

"In regard to overhead wires, we do not object to them. The cost of such a system would not exceed for a double track route $2,500 or $3,000 per mile, while the underground system would cost at least $25,000 per mile, single track. The best of care must be taken of the mechanical part of the road, or the running of the system will end in a dismal failure."

Among those in attendance at the Street Railway convention were F. J. Sprague and H. McL. Harding, of the Sprague Electric Railway and Motor company, of New York. The Sprague company had on exhibition a number of photographs and diagrams of apparatus made by them and roads recently installed upon their system. In the exhibition hall, one of the most noteworthy exhibits was that of the Sprague company. This consisted of one of their improved motor trucks with latest pattern of motor, brushes, brush holders, and gearing. At the Sprague headquarters in the hotel, there was always a large number of street railway men inspecting the different exhibits there

The Bentley-Knight Electric Railway company was represented at the convention by R. W. Blackwell, president, and J. L. Blackwell, secretary. An exhibit was made showing specimens of their conduits and parts of their appliances.

The Ries electric railway and traction increasing system of Baltimore, Md., represented by Elias E. Ries and A. H. Henderson, was shown

The Julien Electric Traction company extended a special invitation to the delegates to the convention to visit and inspect their storage battery car running regularly on the Madison avenue line in New York City.

The J. G. Brill company, Philadelphia, represented by John A. Brill and J. A. Hanna, exhibited a patent equalizer and also patent independent rigid trucks for electrical, or other mechanical motors or cable grips.

Sidney H. Short, representing the Short series electric system, was in attendance.

The Solution of the Municipal Rapid Transit Problem.[1]

By Frank J. Sprague.

PART V.

J. M Pendleton: I have heard several eulogies of the Sprague motor that is used in Richmond, and I would like to inquire whether the motor in use upon the cars in Richmond is anything but a plain, series-wound Siemens armature. If such is the case, it seems to be a very old form of motor—one that certainly has not got anything to give it a title except the maker's name. In these motors, we know that Mr. Sprague has spent a great deal of time and given a good deal of study to certain lines of regulation in motors, but they are certainly not adapted to car purposes; and if a plain series motor is put upon a car, why should we call it one thing or another? Is there anything in the motor except that it is a series-wound motor such as we have been familiar with a great many years, even before we knew the names of a great many manufacturers who certainly cannot claim the invention of a motor of that class?

Mr. Mailloux: While it is true that there are very few types of motors existing, and that, in fact, the question of selecting a type, in the mind of an electrical engineer who is about to design a motor, comes down to but two forms, strictly speaking, yet it does not appear to me to follow necessarily that we should be compelled to give to the motor designed merely the name of that peculiar form. We have only to look into other fields of engineering—and I know no better example than this which he mentions—to see how the names go. If we were to give absolutely to Caesar what is his, the engines that we use to-day would be known by the names of people who lived before we were born. As a matter of fact, while James Watt may have done a great deal for the steam engine, yet it does not follow that he is entitled to the full credit of the steam engine, because if we were to place the engine designed by James Watt in contrast with the engine designed later by Corliss, we would find quite a difference; and if you would come down still further and compare it with the triple expansion compound engines now being made, you would find a still more marked difference. Yet, strictly speaking, they are all of the same type. Now, the criticism made by Mr. Pendleton would imply that in designing a motor you have only to look at a book and find a picture that suits you the best, and then if you decide that it is to be a series motor or shunt motor, you simply go to work and have it made. Now, we who have been through the mill, know that the process is far from being as easy as that. We know that there are very intricate calculations to be gone through, and calculations that must be gone through under very adverse and trying situations, inasmuch as, so far from the art being entirely known, we are, in fact, only in the dawn of knowledge. In other words, the data that we have to work from are very incomplete, and where facts, figures and principles end we must go often into the domain of the hypothetical to help ourselves out. Now, I think that so far from disparaging the efforts of people in designing, we should, on the other hand, certainly give them credit for what they have done, because we ought to realize the amount of study, hard work, experimenting, and oftentimes expense, which have been necessary to enable them to arrive at these results.

F. J. Sprague: I am rather glad that some argument has come up in the discussion of the paper. I think possibly I am in a position to correct some of the impressions which have been received so as to remove doubts about certain points. I do not care to here enter into a discussion as to whether any work that I do shall go under my name or in some other man's. So far as the difference between the Sprague motor in Richmond and the Siemens machine is concerned, either Mr. Pendleton does not know what the Sprague motor in Richmond is, or what the Siemens motor is. We use in Richmond a double commutator machine which is unknown to day to any one except those whom I have taught. Its plan of winding has never been published or described. It is, as I say, unknown except by the employes of my company, and if there is any question as to the similarity of that winding to some other, I have not the slightest objection to giving the necessary diagram of connections. It is a series machine, but a series machine which has some peculiar characteristics. It is wound with three sets of coils, and the peculiarity very largely consists in the method of connecting and certain switches, by which the coils in these machines are commutated and reversed, their field magnetization and their current varied at will, through progressive changes, by means of which, when desirable, we are enabled under various loads to maintain an almost absolutely constant field, while the current may vary 300 per cent. That has never been done with a motor before; that is, to so regulate the field that, with a variation of 300 per cent., a perfectly constant field will be maintained. This field connection is somewhat peculiar, so much so that it would be useless for me to attempt to describe it now, although I shall take occasion to publish a description of it in the near future. There are, however, some characteristics of motors other than the mere winding of the armatures or fields, or their regulation, which are essential for street car purposes. It is, as Mr. Mailloux says, a question partly of proportioning, partly of calculation, a putting together of those things which you have at hand to meet those conditions under which you have got to work. Two years ago, I think I may fairly say, such a problem as equipping the Richmond road, with its abnormal conditions, with the circumstances of manufacture which we had to meet, and in the time that was given to us in the then undeveloped state of this art, would have been looked upon as somewhat preposterous. I am frank to confess that had I known what I had to go through, I would, perhaps, have had neither the necessary courage, time nor patience, nor have cared to have risked the money which I did. I have spent in Richmond $150,000, and I have learned something. While I do not care to state all I learned, I have taken advantage of it in our future work. A great many of the principles of regulation that have been associated with my name are not characteristic of the Richmond machines. They are designed for other purposes. Now, referring to Mr. Leonard's paper, a great many of the deficiencies he speaks of exist in Richmond, and unless the machine were of superhuman design, they must exist there. A year ago those machines were put in in a great hurry. The maximum normal capacity that they ought to run at is about seven and a half horse power. Very frequently they have been called upon to develop ten or eleven horse power, an increase of about 50 per cent. In the nine months during which this road has been in actual operation, and it has run nearly half a million of miles and carried millions of passengers, not one working car has ever been inside of a closed shed. They have been housed in the street. The photograph which you have in the report of the paper read by me some months ago gives you some idea of where the cars have been kept. Of course you are aware that when a machine is running it is exposed to more or less wear. It needs something of care and attention. A locomotive that makes 200 or 300 miles is sent into a roundhouse, thoroughly cleaned, and taken care of. It is a very good locomotive that will run with safety, and it is very poor management that will permit it to run more than 300 or 400 miles without looking it over. The Richmond machines have run sometimes as high as 6,000 or 8,000 miles without being sent inside a covered shed. They have run without covers of any kind or character. They have run with six inches of water in the street and brake-beams running in the water, which was splashing on the motors. They have run until you could not tell what the machine was; until the accumulation of mud and oil and filth was of such a character that no other piece of machinery in the world would ever have run. I am not responsible, unfortunately, for the management of the Richmond railway. If so, we would not have the possibility of a number of cars lying in the car-shed, so-called, unfit for duty, after having been left in the streets during ten days of rain. The report from one of my own inspectors less than one week ago was that there was no more trouble in running a 40-car road by electricity than in one operating three or four cars. He is a level-headed, practical, cautious man, not given to strong statements, and very conservative in what he says or does. He says that out of 30 cars equipped for duty, there is no difficulty whatever in maintaining 29 on the road, if only that legitimate, ordinary, reasonable care is given to the machines which ought to be given to them; and that is the opinion of others who know the exact circumstances of the Richmond management, and the character of the attendance which the machines have had. There is no electric car in the world which has ever made anything like these records—from 80 to 110 miles a day on grades as high as 10 per cent., under loads 50 per cent. above the normal capacity of the machines in the hands of the men oftentimes appointed for political purposes and not for intelligence, on duty twenty hours a day, and making 6,000 or 8,000 miles without going inside a shed to be cleaned off. I have been called a crank, and some time ago when I made the statement, as I did in the paper that was read here, that we would get to that position in electric motors in which it would be almost an impossibility in ordinary use to break them down, and that I proposed to wash machines down occasionally, to get them clean, the remark was made, "Well, that fellow must be a d—d fool." Well, I quietly pocketed that remark, and within the next thirty days or so we will have that machine out, and we will put one of those armatures that people have laughed about inside a barrel of water for twenty-four hours, and we will take it out and we will run it. There is no piece of electric machinery in existence to-day that will stand it. One of the difficulties which will occur on any road where cars are not properly and decently housed some part of the twenty-four hours is this: Cars that are running, of course, warm up, the pores open, they are ready for the absorption of any moisture. If it comes on a cold, damp, murky night, and these cars are left utterly unprotected, they will absorb more or less moisture. In dealing with the potential we are using there of 400 to 450 volts on the line, you have a possibility of a short circuit in the coils. Some of the difficulties Mr. Leonard mentions I think he might have recognized as of a purely mechanical nature, or difficulties due very largely to lack of ordinary care. The breaking of a trolley wire, sometimes caused by a trolley catching in it, can be, of course, almost entirely obviated by one or two precautions; one of these is the non-use of solder in the erection of a line. In putting up the Richmond line we used hard drawn copper. Hard drawn copper, as it comes out of the mill, has a remarkable tenacity, but when it has been handled, and when under the heat of a soldering iron it has been warmed up, you reduce it practically to the strength of soft drawn copper, so that you will have at the point where solder has been applied a weak spot which entirely nullifies all your other precautions. In our future work this trouble will be entirely removed, because we will not use solder from one end of the line to the other. The use of silicon bronze or aluminum bronze, drawn for high conductivity and great tenacity, will likewise render less possible any accident due to the breaking of the wire. This wire can be drawn of from 100,000 to 150,000 pounds tensile strength to the square inch, and being put up without solder, I can see little possibility of that wire ever coming down.

So far as the use of poles is concerned, if you use a green pole, as the poles in Richmond were, it will bend; if improperly set in a clay soil it will get out of position. If it is properly seasoned and set in concrete there is no reason why it should give trouble. One of the most important roads that we have—we have some 26 or 27 now—is the West End road of Boston. Rights for an overhead system there having been granted within a few days, we are putting up a line that costs four times as much as the Richmond line did per mile. I believe I said in my recent paper that the objection to overhead wires was entirely reasonable, because people did not put money enough into them. Having put all the money which I did in the Richmond road, I do not propose to put in any more there. On a new road, where I can make my own conditions before the contract is signed, I am willing to put in just as expensive a road as is desired. Instead of putting in wooden poles in Boston, we are putting in iron poles tested up to 1,400 pounds. Instead of setting them in clay, we set them in concrete. Those poles will not come down. So far as the span wires are concerned there is no danger of their breaking.

As to the use of a single overhead line that I know is a much discussed question. But I find the practice of most people is a single overhead line. There has been a good deal of kicking on the part of telephone companies. It has chiefly disappeared down in Richmond. The trouble is that the telephone companies had the earth, and they wanted to keep it. (Laughter.) I can see no particular reason why a telephone company should not be required to exercise the same degree of care in putting up their lines that they would if the electric railroad were already in existence. The telephone man runs out his circuit as far as he can and charges as much as he can, and then, because some poor railroad company wants to put in some cheap and effective system of operating its cars, I do not think that it is quite just on the part of the telephone companies that they should raise their hands in such holy horror over the use of the earth circuits. Mr. McCluer, of Richmond, who was mentioned, had ingenuity enough to get out of his trouble. He took the trouble to run over his main telephone circuit, where they came near our wires, a single return wire, and he makes his telephone connections to that. His troubles have disappeared. I suppose it might have cost his system a few hundred dollars. If he objected to paying that, I suppose we could have paid it for him, but he has, as I say, overcome his troubles by the most trivial possible expense. If that is the only objection that telephone companies have got, it is not a legitimate objection. So far as the burning out of their exchange is concerned, I will have to correct Mr. Leonard in that. At the time one of their decayed poles fell down and landed three or four hundred wires on top of our lines, the dynamos were not running at all. This is the only pole breakage I know of. We have burned out some of their instruments, but that is simply because we took a reasonable amount of precaution, and they did not. They got their wires across ours, and they got the worst of it The great trouble with telegraph and telephone business is this—the thousands of miles of dead wires hanging down in the streets and over the house tops. A man who has a telephone does not take the trouble to take down his telephone wire after he has discontinued the service. There is no æsthetic sentiment in a telephone company. They are perfectly willing to say: "Here, you electric light people and you electric railway people are causing a great deal of trouble to our customers." If they would all join hands in an equitable arrangement, as some of them have, they would have little cause to complain.

A criticism has been made about the use of two machines on a car. I have spent half an hour trying to get the length of this room with one motor on a 6 per cent. grade, under a condition which happened to give a slimy surface on the rail, and I have seen under the same conditions, on a 10 per cent. grade, on a worse track, two motors handle the heaviest loads. It is not merely because the wheels can get a better grip—you have got your total weight available for traction. The forward wheels can also in case of an emergency travel faster than the rear wheels. That has been done—even on a level, and has the advantage of breaking up whatever obstructions there are on the track and leaving the track perfectly clear; if you put between your wheel a broom or brush you have excellent traction. It could not be done by gearing both wheels to the same motor, simply because you could not get that independence of grip that is necessary. Running both pairs of axles requires certain devices, the use of which, in view of existing street car practice in the matter of constructing running gear, I do not think is advisable. There are some 40,000 or 50,000 cars in the United States, and there are one or two settled principles in them; one is, perfectly independent action of the axles. No four wheels on a car are of the same diameter; they are never cast absolutely alike; they do not run necessarily on the same tread. Any difference in the level of the streets will send the weight of a car down on one side. In fact, it seems to me, in the face of all I have seen, almost trivial to make any objection to the independent driving of two axles. I admit it is cheaper to build one machine to put on a car, but you can build two smaller machines of the same capacity. Space in a street car is a matter of considerable importance. You want to get large power on a car to handle heavy loads, but you have got to have it in comparatively small space.

As to keeping a trolley on a wire, I am quite willing to enter into a contract to put a trolley on a car which never can come off the wire, and, in fact, some of our cars are now running with one man, and have to run with one man, simply because the railroad people wont pay an additional conductor.

The methods of getting rid of troubles have been, of course, subjects of a great deal of study. It was not possible a couple of years ago to look forward and face all the conditions that arise in practice. We electricians did not know enough about street car practice, and street car men did not know enough about electric railways, so we had to join hands with the street car men, and we had to put the cars and motors into the hands of ignorant men and meet those difficulties in order to know how to get over them. I think I may safely say that the road we put in sixty days from now will bear about as little resemblance in details to the Richmond road as it is possible for any two roads to bear to each other, simply because of great improvements, not only in the motors, but in the gearing, switches, trolley work and all overhead superstructure.

A two-wire system requires from two to four times the weight overhead. Where we put a main conductor alongside of the street and reduce the trolley wire to a single one a fifth of an inch in diameter, that enables us to keep our structure in position a great deal better. So far as safety

[1] Read before the American Institute of Electrical Engineers, June 12, 1888; published in Nos. 3, 4 and 5, Vol. 3, Western Electrician. Discussion by the institute, October 6, 1888.

is concerned the fact that a horse was killed in Richmond in the early days of running, is no criterion of it. Two wires are more liable to come down as one; but you wont get killed with 400 or 500 volts. I have several times taken that potential myself. We don't know whether the horse that was killed in Richmond broke his neck or was calle t by electricity. He was boiled in order to get his skeleton; he did have a broken neck; it is not known whether that killed him. We had a mule there. (Laughter.) A man threw a lump of ice down on to our wires. The first mule —two of them were being driven by a darkey—ran his head into the wire and kicked, and finally fell down and lay on the wire. About half an hour after that they telephoned up to the general manager's office, and said, "We have got a mule pretty well used up by a current; we want damages." He said, "All right." About 48 hours afterward they sent up word that they did not think they wanted any damages; that mule seemed to be a great deal livelier than before. (Laughter.) In the case of the horse, that was gross carelessness on the part of everybody concerned—the conductor who broke the wire, the dog who investigated it, and the boy who rode the horse, but the only one injured was the horse.

The statement that the Richmond company has never been able to run more than thirty cars out of forty, is an error. The Richmond road never expected to run more than thirty cars out of forty. Its plant was built for thirty cars. A forty car motor equipment had nothing to do with their line work, or their central station work. It is perfectly possible, as a matter of fact, to run the entire forty cars.

As far as the use of the storage battery is concerned, I am just as anxious as anybody else that the storage battery should be a success. But it will never get on a car in Richmond when they have got to put 4,000 pounds weight on that car. They never will take 20,000 pounds weight up a ten per cent. grade with a storage battery until it is in a good deal higher state of efficiency than it is to day. We have, although not prominently connected with storage battery work, been experimenting for a long time. We keep a car on tap. We have had built hundreds of plates in the past year, trying to devise some means of overcoming some difficulties that exist in storage batteries now. We hope to have a normal capacity of discharge in, say, a 35-pound cell of not less than 75 or 80 amperes, and that they can stand 150. The resistance ought to be about one-third or one-fourth of the present storage battery. The plates will be practically indestructible; and finally, it won't be a Faure cell. That is the sort of thing I am looking for. I do not know whether we will get it. The results, so far, have been very encouraging, but we never will attempt to climb a 10 per cent. grade with it, and we never will put it on the market until we know it is satisfactory. We will do our own experimental work. We expect to get the battery down so that not more than 1 800 pounds is necessary to handle the car under ordinary conditions. That will be something of an advance. The credit will not be mine, except that I have to pay the bills. Two years ago it was not possible to design a street car motor for entirely perfect work. I do not think enough was known about street car work. Certainly we are in a position to-day to design a great deal better machines than we did then. I shall have the pleasure of showing and explaining to this association in the near future our two latest machines—one about 7½ horse power, the other about 15—and their construction, I think, will appeal to street car people at least. I think by the time the Boston road is running, which will be in about five or six weeks, if Providence is not against us in the matter of the weather, we shall be able to show such improvement to the overhead line, as to its efficiency, economy and appearance, the character of the motors and the work which they will do, as will be a subject for mutual congratulation.

L. F. LYNE: I would like to ask Mr. Sprague if he really meant that a locomotive only runs 150 miles before it needs repairs. I think he meant 1,000.

MR. SPRAGUE: I might as well correct that impression at once, if you will permit me. I said it was not practicable in locomotive work to run over 200 or 400 miles without the locomotive going under shelter, and being properly oiled and cleaned; I did not mean going into the repair shop. What I say about the Richmond machines is this: They are not put inside of four walls; they are simply left in the streets. You cannot have a locomotive or any other machine in the street for eight months under all conditions of the weather and have a machine that will not be apt to sometimes give you trouble.

I was quoted a little while ago as making a remark about hill horses. I was asked by a man who was interested in storage batteries—I believe he lived in New Jersey—if I would recommend in the equipment of a road which ordinarily did not have more than two or three per cent. grade, but which did have in some particular places a heavy grade of 8 or 9 per cent., the use of motors which would climb a 9 per cent. grade? I said that as a matter of commercial investment I would say no. I said: "You will find it cheaper if, when you get to that 8 or 9 per cent. grade, you take the trouble to put on a horse." That certainly was the intention of my remark.

So far as Richmond is concerned, I did not expect in the first place, that we were going to have a 10 per cent. grade there. Our specifications are for 8 per cent. We have in some places the equivalent of a 13 per cent. grade. We develop a remarkable traction, a traction which I never anticipated would be gotten out of a car; but no matter how we magnetized our wheels there, unless we drove both axles we never would get up these grades at all times.

MR. LYNE: There are one or two remarks made by Mr. Leonard that I would like to refer to. The devices, so far as I have been able to discover, in transmitting the power from the motor to the shaft of the car or axle of the car, have been in many cases obsolete devices. For instance, the grooved friction wheel has been used on the "Ben Franklin" that was tried on the Ninth avenue road. That device was mentioned by engineers years ago, because the friction wheel caused flat places. If a sufficient pressure was not brought to bear on these wheels to bring it up to the maximum point at once, the surfaces would slip on one another, and the axle would have a flat place. When the Fontaine locomotive came out we were led to believe that the whole railroad system of the country would be revolutionized in a few months by that engine. A certain few predicted its utter failure, and it failed, principally in consequence of the tires getting flat places on them. As soon as they did get a flat place they began pounding themselves to pieces, and the result was a dismantling of the whole affair. We know that the same thing occurs in locomotives in climbing grades. They slip, get flat places, and then the wheels have to be turned off, or the tires rather.

MR. SPRAGUE: The question of depreciation of line is a question of construction very largely. It is certainly not a question of wear. A consideration of the actual time in which a wire is in contact, will show this. With cars that are making two-minute headway and running seven miles an hour, with a round trolley wheel making contact on a round wire, we have almost a line contact, but call it an eighth of an inch contact. Any portion of the wire is in actual contact with the wheel less than one two-hundred-thousandth part of the time; in other words, in continuous current contact, not over one hour in twenty-six years. Consequently the current ought not to rapidly wear the wire out, and it does not. In fact, the period in which any particular part of the wire is in contact is not over one two-thousandth part of a second when the car is moving seven miles per hour.

The questions of insulation, leakage and lightning came up a little while ago. It is a remarkable fact that lightning does not necessarily follow always the single overhead wire. We have had in Richmond quite a number of cases of the line being struck by lightning. Our ground circuit is made by three paths; two through the boilers and water connections, and a third through by a covered wire running about 1,000 feet on poles out, and direct down, to the track. We have had lightning come over that wire several times, and the statement of the engineers is that it is about an even thing whether it comes in on that line or the other one. It terminates in a well, and as a matter of scientific interest the engineers sometimes watch it as it goes into this well. So far as the leakage is concerned on that line it can easily be reduced to an average of one-tenth or one one-hundredth part of one per cent. It has never been sufficient to cause the slightest interference with the operation of the wire, except in the case of the short circuit. If existing, it can very easily be perceived by taking the reading of the ampere meter. The leakage is nothing so far as loss of power is concerned.

D. E. LAIN: About the only part of the matter that I wish to speak of now is the means of coupling the motor to the axle. In Mr. Sprague's excellent paper he compares the method of direct coupling with the others, coupling by means of a chain gear, friction gear, etc., in a way which, I think, was rather hard on the direct coupling. I have had some experience with some of these ways, and it seemed to me that the method of direct coupling offers certain advantages which no other method offers. The easy motion and perfect noiselessness of the coupling certainly place it ahead of any other means. The simplicity, of course, in this method is greater than in any other. All the details are reduced to a minimum. The objection, of course, is that on account of the slow speed which the armature must necessarily run, running no faster than the driving wheel—a larger machine is necessary. This may be an objection, and may not. In street railway work, where certainly not more than 10 horse power is intended, where the whole equipment should not weigh more than, say, 5,000 pounds when the car is loaded, the weight of the motor enters as a part of the whole weight; with the weight of a direct coupled motor, that it is not of such great importance after all. If the drivers be reduced to, say, 18 inches, or thereabouts, a motor can be built that is not necessarily over 25 per cent. greater in weight than one using gearing. This small difference is due in part, at any rate, to the greater efficiency of direct coupling over the gear. Of course, gear transmission is not possible where speed is reduced or changed from, say, one to twelve or one to ten without some considerable loss of power. All this is saved in the direct connection where the loss by transmission should not be more than a very few per cent. I think before the close of a year, at least before the close of next year, results will be obtained with direct coupling that will show it is possible to use a direct coupled motor, even for so small work as street car work, that is quite as efficient, taking it all the way through, and taking the total efficiency of the system, as gearing.

M. B. LEONARD: With reference to the statement in my paper regarding the burning out of the exchange, that statement was based on information I received from the telephone manager's office yesterday afternoon. In regard to the difficulty and trouble experienced by the telephone exchange people on account of the ground circuit of the electric railway, it has been largely, if not altogether, remedied by the erection of a metallic circuit, or what amounts to the same thing, namely, running on a large copper wire to which the telephone wires are grounded, instead of going to a gas pipe, as ordinarily they do. The difficulty has been obviated in that way, but there are quite a number of private telephone lines put up by various people, including our railroad company, who cannot afford to go to the expense of putting up metallic circuits, and the result has been that we have been obliged to discard our private telephone line and pay tribute to the telephone company and their metallic circuit system. With reference to the mechanical difficulties which Mr. Sprague alludes to, and which, of course, have been improved since the road was first erected, it is true that those mechanical difficulties can be considered as such by observation; but the electric road at Richmond was put forward as being a sample, I may say, of what has been accomplished, and of course we could only take what was actually being done, and criticise it accordingly. This I endeavored to do in the few remarks I made. That the work is susceptible of improvement is, of course, at once apparent to almost every one, and that Mr. Sprague has in other cities succeeded in improving on the overhead system is nothing more than what would be expected from the ingenuity and skillfulness with which he has overcome all the difficulties that were encountered in the Richmond enterprise.

T. W. RAE: There is nothing that I have to say in addition to the remarks that have been given to-night, but I would like to record my hearty concurrence with Mr. Sprague's dictum respecting overhead lines. It is simply, as with most engineering questions, a financial rather than a technical one. One may have a good, durable, sightly overhead line by simply paying sufficient money for it. As at present constructed they do develop obstacles of various kinds, and certainly are not as symmetrical as they might be, and do lack the perfection that might be given by the expenditure of more money. This question arises: It is quite possible, I think, to make use of an underground conduit at, perhaps, no greater expense (certainly no greater, when one considers the cost of maintenance of a properly built conduit) than a properly built overhead system would entail, and the difficulties which Mr. Leonard referred to I think cannot fail to be recognized by everybody; but that they are essentially inherent in the system does not necessarily follow, as Mr. Sprague has pointed out very clearly.

MR. SPRAGUE: I think we will know much more about it when we have gone through a northern winter, which we shall do very soon. We have cleaning cars and we shall put ample power behind them, and can do it much faster than with horses, because we have the power behind us rather than ahead of us.

DR. WHEELER: Mr. Sprague mentioned the fact that the wire could not possibly wear, because it was only in contact at one point a very small part of the time—about a thousandth of the time. I should think that wear would be caused by every minute jump that the electricity would have to make when the roller hops a little bit off the wire. In fact, when he said that the roller was only in contact with any particular part of the wire about a thousandth of the time, I thought he only referred to the danger of its hopping off.

MR. SPRAGUE: It was not that to which I referred. It is not the same as a sliding contact on the wire. Your wheel is wearing all the while, and there is no difference of condition between the part you leave and the part you are going on. You take a good conductor where your trolley is held up by a good spring; you may inspect that wire by a microscope, and detect very little signs of wear at all. There would be a very slight frictional wear, and it is probable there is a certain percentage of slip of these trolley wheels on the wire. I have, after eight months' wear on the very heaviest portion of the line, very carefully inspected the wire, which was clean, and I was agreeably surprised to see the small effect upon the wire. If there is no sparking, the wear is entirely due to friction. The fact is, the wear is remarkably light on the wire.

I would like to make one remark in regard to lightning. We had the line struck by lightning a good many times, and we have had motors on cars burnt out, but I believe I may safely say now that we have got lightning pretty well harnessed. I believe now there is no difficulty whatsoever in absolutely and perfectly guarding a car in a central station, so that lightning simply cannot get to the machine. We had three darkeys sitting on the back dashboard of a car; one of them was sitting on the switch. The lightning came in and grounded through the switch. Those three darkeys jumped off the car very lively. We have had the lightning come in and ground through the switch at the time the motor men were running through the car. They paid not the slightest attention to it. They simply heard the click; that was the end of it. It cannot get into our machines and it cannot get into our stations; at least if it does it is only one time in 10,000, and then it goes to earth harmlessly.

MR. POPE: I will call on the chairman of the committee on papers and meetings to make the announcement for the next meeting.

T. C. MARTIN: The next meeting will be held on November 13th. The subjects are as follows: Prof. W. E. Geyer, of the Stevens institute, will read a paper on "A new motor for direct and alternating currents." We have with us this evening a gentleman whose acquaintance I think you will all be glad to make. He is one of the leading electricians and mathematicians of France; he is also well known as one of the leading contributors to the leading electrical paper of France, *La Lumiere Electrique*. I am very glad to announce that on some evening that gentleman will favor us with two papers, both of which will be accompanied by experiments and demonstrations; one will be on the Carpentier electrical method of recording and reproducing music; the other will be on the Abdank magnetic coil.

(*Concluded.*)

Electricity as Applied to Sea Coast Defences.

The regular lecture season of the New York Electric club opened October 18th, at the club house, 17 East Twenty-second street. President Davis introduced Capt. Zalinski, who discussed thoroughly the departments of naval warfare to which electricity has become absolutely essential. He dwelt on the importance of range and position finding, and described the two methods generally used. He referred to the work done by Major Watkins and Lieutenant Fiske in this field, and stated that much of the progress recently made could not yet be divulged. He felt confident however, that when it was demonstrated what the Vesuvius could do in accuracy of firing, it would be recognized that good work had been done. He considered that though the result achieved by the search light had been in the main satisfactory, much remained to be done. Automatic regulation, he added, had not reached the point at which it would be preferable to hand regulation. In handling guns the electric motor had advantages over both steam and compressed air. Important experiments had been going on on the Chicago, and although the results had not

been perfectly successful, he had little doubt of the thorough adaptability of the electric motor in the near future, for this purpose In discussing submarine torpedoes, Captain Zalinski detailed the characteristics of the three general classes of primers, and showed that of the high, medium and low tension fuses, the last was the most to be commended. He also bore testimony to the uniformity of the results obtained by H J Smith in his experiments with primers. In treating of submarine mines, the lecturer emphasized the absolute necessity of extreme care in the preparation of the materials employed, and the indispensability of electricity for their successful operation. He commented on the progress made in England in this department, and urged the electricians here to turn their energies in the same direction. In analyzing the nature and force of high explosives for submarine work, he decided in favor of gelatine over both dynamite and gun cotton.

Some effective stereopticon views were introduced to illustrate the working of the submarine buoy mines, and they were followed by descriptions of the English and the Russian circuit closers, and an explanation of the process by which the torpedoes are exploded. The lecturer described the English cut-off, and said that although he could not show his audience the American form, he assured them that it was a much better one. After treating of countermining, Captain Zalinski spoke at length of the different kinds of fish torpedoes, their speed and effects, and then proceeded to the pneumatic gun with which his name is so intimately associated, and gave an interesting account of its evolution, and of the effective series of experiments on the Silliman, the various stages of which were shown by the stereopticon His reference to a view of the Italia, an Italian man of-war of 15,000 tons, which could easily be destroyed by the pneumatic gun, gave point to his remarks on the inadvisability of spending immense sums of money on such ships in the transitional state of modern naval war appliances.

New York Board of Electrical Control.

An important meeting of the Board of Electrical Control was held October 17th. Evidence was given of the determination of the commissioners to secure a speedy solution of the subway problem. A letter was sent to nine electric lighting companies urging them to meet the board on the 19th, for a general discussion of the question. The letter set forth that: The possibility of placing electric light conductors underground during the present season, is confined to a comparatively small area of the city, where subways have been constructed, and the opposition met with on the part of corporations engaged in the electric lighting business, to the burial of their wires, together with a lack of co-operation on the part of certain officials, renders it impossible that a much greater area will be provided with subways in the near future." It is further stated that the board was satisfied that there must be reconstruction and was prepared to put before the meeting of the 19th a plan for overcoming the present obstacles, in accordance with rules and regulations by Expert Wheeler. The letter continued: "It is the opinion of the committee and the board, that under proper regulations, the use of electric conductors for high tension currents can be made reasonably safe, and it is believed that the welfare of the corporations demand this co-operation, and that by refusing privileges to companies which do not comply with its rules and regulations, the board can eventually compel such a compliance. If the electric light companies will cooperate with the board in its endeavor to reform this great and crying evil, they shall be allowed the necessary time and opportunity to effect a reform without interfering with their business."

The report of Expert Wheeler showed that 283 notices of violations of the rules and regulations of the board had been sent to the Bureau of Incumbrances. "Of these 183 relate to dead wires, none of which has been acted upon; 100 relate to dead poles, of which 40 have been acted upon; while 60 remain unattended to. The last comprise all the notices but 13 of dead poles and dead wires belonging to the United States Illuminating company, and about 33 miscellaneous notices The 40 notices which have been acted upon by the Department of Public Works have entailed the removal of 312 dead poles, and 404,183 feet of dead wire. There have been 215 new notices of violations of rules and regulations since the last meeting of the board." The report then goes at length into the progress which is being made by the different companies.

In discussing an application from General Manager Eckert, Commissioner Gibbens stated that the Metropolitan Telephone company had done more work than any one else. The amount of work entailed on such a company in making the change from the overhead to the underground system, was enormous; and they had already spent in these operations, in the lower part of the city over one million dollars. Mr Gibbens added: "I do not know that this board is warranted in being dissatisfied with anything the Metropolitan Telephone company has promised to do; I shall move that their application be granted."

A communication from the Consolidated Telegraph and Electrical Subway company was referred to the engineer of the board, to report whether it was in accordance with the general plan of the board. The petitions of the Electric Power company, the Manhattan Electric Light company, and the Empire and Bay State Telegraph company were referred to a committee to be appointed by the chair to report at the next meeting. The secretary was directed to notify the Harlem Electric Lighting company than it had violated the law in putting its wires on two poles to One Hundred and Twenty-fourth and One Hundred and Twenty-fifth streets and First avenue

It was reported that the wires in Second avenue, between Sixty-fourth and One Hundred and Twentieth streets, had been removed, as were also the poles on Sixth avenue, from Twenty-first to Fifty-eighth streets. The Western Union and other companies reported their intention of removing wires from the streets and placing them under ground.

The bad condition of conduits in Park Row and lower Broadway was brought to the attention of the board, and the fact was made known that, owing to leaks from the New York Steam Heating company's pipes, the temperature in the conduit manholes rose at times to 209°.

A special meeting of the board was held October 19th. The Western Union Telegraph company presented a complaint against the Steam Heating company, alleging that by the proximity of the latter company's pipes the cables in the subways down town had been ruined. A letter was read from the chief engineer of the Subway Construction company, in which the results of a series of tests were given. In lower Broadway in many places the temperature was found to be excessively high, and President Lauterbach of the Subway Construction company, attributed the whole of the blame to the Steam Heating company. President Andrews of that company argued that the grievance was traceable to leakage from the Croton water mains Cold water worked its way into the hot steam tube chambers, and steam there generated oozed into the subways. He finally admitted, however, that the whole source of trouble was the wooden wedges which had been used by the engineer, instead of cast iron wedges, for holding the pipes together In seven years this little error had cost the company $250,000 Mr. Andrews expressed his perfect willingness to accept the decision of the board's engineer as to the responsibility for the blame in the matter, and if held liable, he would do all in his power to remedy the fault.

Conditional franchises were granted to the Electric Power company, and the Manhattan Electric Light company, limited. The plant of the latter, at Avenue B and Eightieth street, covers five city lots. The company has exclusive control of the Slattery induction system A plan for reconstructing electric light pole lines pending the completion of the underground conductors, was discussed.

Lamp Lighting Schedule. — Moonlight System.

NOVEMBER.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	5.30	5.30	12.00
2	5.30	5.30	12.00
3	5.20	5.30	12.10
4	5.20	5.30	12.10
5	5.30	5.40	12.10
6	6.30	5.40	11.10
7	7.30	5.40	10.10
8	8.30	5.40	9.10
9	9.30	5.40	8.10
10	10.40	5.40	7.00
11	11.40	5.40	6.00
12	12.40	5.40	5.00
13	1.40	5.50	4.10
14	2.40	5.50	3.10
15	3.40	5.50	2.10
16	4.40	5.50	1.10
17	No	light.	0.00
18	No	light.	0.00
19	No	light.	0.00
20	5.10	7.20	2.10
21	5.10	8.00	2.50
22	5.10	9.00	3.50
23	5.10	9.50	4.40
24	5.10	10.50	5.40
25	5.10	11.50	6.40
26	5.00	12.50	7.50
27	5 00	2.00	9.00
28	5.00	3.10	10.10
29	5.00	4.20	11.20
30	5.00	5.30	12.30
	Total number of hours,		204.30

The foregoing schedule is practically good for the United States.

The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

Thomson-Houston Boston Offices.

The Thomson-Houston company of Boston has moved into new quarters in the Hathaway building, Atlantic avenue. The offices are lighted throughout by 150 Thomson-Houston incandescent lamps. The dynamo is operated by a 15 horse power Thomson-Houston motor, which receives its current from the Boston Electric Light company's station. The offices are all finished in cypress wood, and fully equipped with speaking tubes, electric bells, etc. The corner office is occupied by C. A. Coffin, vice-president and treasurer of the company, and adjoining this office is the one occupied by Capt. Eugene Griffin, manager of street railway department. The large office fronting on Atlantic avenue is devoted to the railway department, and adjoining this is the office of the International company, of which Geo. W. Davenport is the manager, assisted by S. C. Peck. In the railway office are found G. W. Mansfield, the electrical engineer of this department, and Winthrop Coffin. A part of this office is also given up to the department of advertising and printing, in charge of H. B. Prindle. In the rear of Captain Griffin's office is the office of E. I. Garfield, secretary of the company, and adjoining is the office of W. F. Pope and J. P. Felton, the shipping clerk. The large main office in the rear is occupied by the head bookkeeper, E. M. Bailey and his assistants. In this office alone there are about 100 feet of desk room. Directly opposite and separated by a glass partition is the department given up to the desks of the various agents of the company. The extreme rear of the second floor is occupied by the supply department, which is in charge of C. B. Davis. Adjoining this is the engineering department and draughting room, of which H. C. Patterson is manager. At the left of the entrance are two offices, one of which is used as the consulting office, the other being occupied by the company's attorney, Robert P. Clapp. Directly opposite the entrance is the telephone box in which are found three telephones, the long distance, a private line to the company's large factory in Lynn, and the Boston exchange.

CORRESPONDENCE

New York Notes.

NEW YORK, Oct. 17.—The engrossing topic just now in electrical circles is the agreement that has just been entered into by the Westinghouse Electric company of Pittsburgh, Pa., with the Consolidated Electric Light company of New York. The onward march of the Westinghouse company in securing rights to patents involved in the manufacture of lights and dynamo, has been steady and persistent; but although the absorption by it of smaller companies, especially in western cities, has been part of the policy of the company, there were many who were not quite prepared for the sweeping acquisition by which it has so firmly established a foothold in this city. By this agreement the property of the Consolidated company, which consists of a big manufactory of the Sawyer-Man incandescent lamps at 510 to 532 West Twenty third street, and an equally big manufactory at Pittsburgh, as well as of all the personal property, consisting of machinery, etc , in those buildings, is placed absolutely under the control of the Westinghouse company; to which is also given the use of all the patents possessed by the company, and the entire capital stock of the Sawyer-Man Electric company. For the use of these the Westinghouse company agrees to pay to the 150 stockholders of the Consolidated Electric company $150,000 every year during the continuance of the agreement. This amount will be paid quarterly, and will amount to a yearly dividend of 4 per cent. until certain indebtedness of the Consolidated company is liquidated, when the dividend will be increased to 6 per cent. The Westinghouse people further agree to pay 1 cent for every Sawyer-Man lamp sold, and it is anticipated that the income from this source will double the annual dividend of 6 per cent. The Westinghouse company also contracts to subscribe for the unissued stock of the Consolidated company, now amounting to a par value of $125,000. The duration of the contract is indefinite; that is, it will continue until the Westinghouse company violates some of its provisions. The Westinghouse company has now opened offices at 510 West Twenty-third street. President Hugh R. Garden of the Consolidated company has published a notice calling for a meeting of the stockholders, October 25th., for the purpose of acquainting them with the arrangements he has made with the Pittsburgh company, and has also mailed copies of the formal agreement to the stockholders. This change will probably be appreciated by investors in Consolidated company stock, which has for a long time paid no dividends, but which will now give 4 per cent., and possibly more. That company is to retain its present organization, but becomes merely an investment corporation, whose sole duty it is to transfer stock and pay dividends. The officers of the Westinghouse company, which has a capital of $5,000,000, are George Westinghouse, jr., president; H. M. Byllesby, vice-president; J. Caldwell, treasurer, and A. T. Rowland, secretary. The Consolidated company has a nominal capital of $2,500,000. Its officers are Hugh R. Garden, president; Jacob Hays, vice-president, and Henry C. Davis, secretary.

The Edison Electric Light company has for a long time been trying to secure a franchise to lay its wires in Brooklyn. For over a year the aldermen have opposed the company, and so prevented any competition with the Citizens' company, which is composed almost entirely of local democratic politicians. The Edison people went to Albany and had a special bill passed, but Governor Hill vetoed it. He did so against the advice of Mayor Chapin, and even evoked a vigorous protest from the *Eagle*, the principal Democratic paper in the city. Oil has, however, been poured on the troubled waters. In a recent letter to the board of aldermen, Mayor Chapin urged immediate action in the matter of electric lighting. He closed his letter with a paragraph praising Governor Hill, and quoting from one of his veto messages to show that he was a lover of home rule. Whereupon the board unanimously adopted a resolution granting permission to the Edison company to lay its conduits and wires, if it began the work within ten days.

The fifty-seventh exhibition of the American Institute is now open. There is a very fair show of electrical exhibits, and the New York state fish commissioners have six large aquariums full of all kinds of fish. These aquariums are illuminated with incandescent lamps suspended under the

water, and have a very pretty effect. This work was carried out by the Tucker Electric Construction company, who have also a most effective setting of colored lamps and shades among the plants around the big fountain. The Mather dynamos furnish the current for illuminating the exhibits, halls, offices, etc. The Waterhouse Electric company have four 35 arc light machines used for the general illumination of the fair. The United States Electric Light company have a fine exhibit. On the under side of the canopy which covers the exhibit are 350 sixteen candle power lamps arranged as stars. Otis Brothers, with two of their Baldwin gas engines, running two small United States dynamos, make a brilliant show of 100 lamps, fifty of which derive their current from 35 Julien batteries, which have been stored during the day by the 3 horse power engine and dynamo. P.

Kansas City, Mo.

KANSAS CITY, Mo., Oct. 18.—Some months ago a bill in equity was filed by the Bell Telephone company in the United States circuit clerk's office in this city, praying for an injunction restraining the Johnson County Telephone company from infringing on its patents, and asking that that company be debarred from carrying on the telephone business in its district.

No restraining order was granted by the court, the presiding judge first desiring to hear arguments before even a preliminary injunction was granted. A few days ago the Johnson County Telephone company filed its answer to the bill. It alleges that it has not information sufficient to form a belief that Professor Alexander Graham Bell was the first original inventor of the speaking telephone; that there are suits now pending in the United States supreme court involving this question. The Missouri & Kansas company, however, agreed to allow the Johnson County Telephone company to establish a telephone service on the condition that it did not compete with it, or use its instruments. This the Johnson County Telephone company says it did, using the patents of the Pan Electric Telephone company, so as not to infringe on the patents of the Bell company. It invested large sums of money in constructing and improving the system. It then makes the statement that it furnishes telephone service to its subscribers at the rate of $27 per year for business offices and $21 per year for residences, while for the same service the Missouri & Kansas Telephone company charges $72 per annum in Kansas City, and the expense of operating a telephone in sparsely settled districts is much greater than in great centers of population. It farther alleges that at the rates now charged its service can be fully and satisfactorily met, fully paying all the expenses of operating, and with a reasonable return on the investment. It avers that the Bell Telephone company, in refusing to place telephones in the districts mentioned, has abandoned them under its franchise from the State of Missouri. It alleges that it is willing to pay a reasonable royalty if the court so decrees without increasing the fees of its subscribers. It asks the court to discharge the injunction and grant the equities in the proceeding. Not only the Johnson County Telephone company is interested in the suit, but the people of Holden and Warrensburg, the towns in which the company operates, are backing the company, and a bitter fight is expected, in which the validity of the patent is involved, and it does not desire to become merged in any lengthy suits known as "telephone suits." It sets forth that for a long time the people of Holden and Warrensburg have had large business transactions with each other, which is greatly facilitated by the use of the telephone. The Bell Telephone company was petitioned to establish telephones in these counties, and the petitioners were referred to the Missouri & Kansas Telephone company, its assignee. The latter company refused to place telephones in these counties, on the ground that it was unadvisable and unprofitable.

Chief Hale of the fire department has finished twelve of the "telephone fire alarm" boxes, by means of which a person desiring to turn in an alarm can obtain direct connection with the fire department headquarters at once without calling up "central," a full description of which has already appeared in the WESTERN ELECTRICIAN. These have been put up, and arrangements are being made for giving them a thorough test. The boxes have been placed at the newspaper offices, the Midland hotel, the board of trade building, police headquarters, and other public buildings.

The Kansas City, Kan., Electric Light & Power company has warmed the cockles of Charlie Cone's heart by extending through him to the Electrical Supply company of Chicago an order for thirty miles of P. & B. wire. Mr. Cone says that's nothing, that his heart is warmed that way so often that he is afraid of the heart disease. The American Electric Light company and the Consolidated Electric Light company have also raised the temperature of his vital organ to the extent of five miles of P. & B. wire each.

The Western Electric Lock company has been organized here, with a capital stock of $100,000, which means that at least $50,000 is paid up. Major B. F. Jones, superintendent of the National waterworks plant in this city; E. L. Martin, of Martin, Perrin & Co., the distillers, and who are also interested in the Home Signal and the Postal Telegraph company, and Alfred W. Jones, are the incorporators.

KANSAS CITY, Mo., Oct. 20.—The Inter-State Electric company has received a high tension dynamo, made expressly for the company by the Detroit Electrical works, for charging accumulators at distances from the central station. The company has arranged to locate several sub-stations in this city and in Kansas City, Kan., just across the river. The Inter-State company has closed contracts to light the general offices of the Kansas City, Fort Scott & Memphis Railroad company in this city and a number of business houses. Two hundred lights will be placed in the railroad company's offices. The Inter-State has also secured the contract to establish an accumulator station at Holton, Kan., and is wiring the buildings of the Chicago, Kansas & Nebraska Railroad company at Smith Center, Kan. The company is considerably delayed by the non-arrival of accumulators from the New York factory. It seems that the accumulator system has become so popular that the factory is flooded with orders, and is several months behind with its work.

The building occupied by the Inter-State company, the Keith & Perry building, is rapidly nearing completion, and when finished will be a model modern building It will be lighted by the Inter-State company, the electric light fixtures being furnished by Wilmarth & Co. of Chicago, and the Western Electric Construction company doing the wiring. H. J. Bruner & Co. of this city furnish the electric bells and speaking tubes.

The Inter-State company is arranging for the manufacture of an electric wagon. Accumulators will supply the motive power.

O. C. Steele, agent of the Brush Electric Light company at Kansas City, Mo., is installing an arc plant at Norton, Kan. A.

Newark, O.

NEWARK, O, Oct. 20.—During a thunderstorm here recently the lightning struck a house, which was not unusual, but this is the curious part of it: The charge entered at a chimney on top, passed down to the first story, across a large room, near the ceiling, and down to the level of a shelf in a kitchen safe, which contained a teacup half full of gunpowder which it exploded, blowing the safe into "pi," as the printers say. It then crossed to the other end of the shelf where there was a copper powder flask nearly full of powder, and out of the corner of the house into a tub of water; it made its mark from the roof to the place of exit. There were three ladies and a child in the house, who were not hurt in the least. Your correspondent has the flask with the powder still in it, but when he got it a few minutes after the occurrence it was so hot it was uncomfortable to hold in the hand.

Newark has a variety of lights. The B. & O. R. R. shop has a 55 light Thomson Houston arc plant, ably cared for by A. Savage. The United States company has a nice plant in connection with the gas works, of which Jas. H. Smith is president

The Western Electric company and the Westinghouse Incandescent company have a joint plant, and are doing a good business. Wm. A. Veach is the manager.

The city has a telephone exchange second to none under the capable management of Joseph Brennan.

Newark is about to have an electrical street railroad between this city and Granville, a distance of about seven miles. Benson Bidwell's conduit will be used. The company has recently reorganized, its officers now consisting of J. V. Barner, president; P. S. Phillips, vice president; F. A. Crane, treasurer, and W. R. Kimball of Chicago, secretary. The directors are: R. Scheidler, Dr. Sedgwick, J. V. Burner, F. A Crane, P. S. Phillips, Wm. A. Veach, Wm. E. Miller, W. C. Christian and Edward Kibler. The electrical house fitting and general wiring work is attended to by D. N. Osyor, who has had a nice trade, and has a fair prospect for more. His former partner, H. F. Lowther, has retired, to engage in other business. P.

Indianapolis, Ind.

INDIANAPOLIS, Oct. 20.—A new electric light and power company has been organized here under title of the Merchants' Electric Light & Power company. The company is composed of several of the leading business men of this city. They propose to establish a plant to furnish light and motive power, and have asked the city council for a franchise, with the right to use overhead wires until some system is adopted for underground wires, and all electrical companies are required to bury their wires. The company agrees, in case it is granted a franchise, to pay to the city a certain portion of its gross receipts and to begin work on its plant immediately. The ordinance was read in the council Monday night, and some of the friends of the new enterprise endeavored to have the rules suspended and the ordinance placed on its passage, but this was defeated and it will take the usual course.

The McNeal syndicate in the east has written accepting the ordinance granting a charter for the construction of an electrical street railroad on the south side. M.

Topeka, Kan.

TOPEKA, Kan., Oct. 13.—J. B. Bartholomew of the Rapid Transit railway company, states that the company has completed arrangements to put the electric system on its line, and take off the steam motors. The contract has been closed, and work will commence in a few days on the new plant. "The company has for a year or more been investigating the various systems of street railways with a view of securing the best in the land," said Mr. Bartholomew. "We have inspected the workings of everything that is made for the propelling of street cars, and we are satisfied beyond any doubt that the electric system is the best system in use at the present time. It has been thoroughly tested, and it has been proven that it can give quicker service than any other power. Our steam motors have been quite satisfactory, but they cannot give the quick service that the increasing travel of our road demands. We will have a 600 horse power central plant, and will operate fifty cars, This will be the largest electric street railway in America. We hope to have a portion of the system in operation by Jan. 1."

The city council has granted the Rapid Transit company the right to operate its line by the electric system instead of steam motors. The company has done a profitable business this year, and it is its intention to build several additional lines next year.

President Whitney, of the Boston street railway, was in the city this week, and at its request delivered a lecture before the council on electric railways. B.

Detroit, Mich.

DETROIT, Oct. 20.—Carelessness on the part of a house mover caused an accident Thursday last, which came pretty near resulting in loss of life, and as it was, did considerable damage to property. A house being moved on Grand River avenue was so handled as to bring it into collision with the guy post of an electric light tower, thus causing one of the guys to be completely torn out of its fastening. The result was that the tower began to sway, pulled out the other guys, and then broke at a point about 40 feet from the top. Section after section followed, until the tower lay in a heap. Robert Seeley, a trimmer, was descending the tower at the time of the accident, but jumped from the elevator to the lower section, and escaped with a badly bruised hip. The company will prosecute the house mover, endeavoring to secure the cost of the tower, $900.

Articles of incorporation of the New England Copper company, capital stock $250,000, have been filed with the county clerk. The company is organized for the purpose of smelting, refining and manufacturing metals, the works to be located within Wayne county.

The United States Electric Light company will install a plant in the Marquette prison.

The Michigan Phonograph company has increased its capital stock to $500,000. C.

Kansas Towns.

HOLTON, Kan., Oct. 19.—The Holton Electric Light company has been incorporated. The capital stock is $20,000. The directors are Milton B. Smythe, Louis A. Walker, Sebastian Globe, John Q. Myers, and John S. Hopkins. D.

LAWRENCE, Kan., Oct. 18.—A meeting of the stockholdets of the old Great Western Telegraph company was held last week. Twenty-one years ago the company was organized with headquarters at Chicago; 3,370 shares of its stock were subscribed for by seventy-three citizens of Lawrence. Nearly every one is familiar with the manner in which Jay Gould's Western Union swallowed it up, freezing out all of the small and some of the large stockholders, among whom was Senator Farwell of Illinois. He has lately brought an action for the benefit of himself and all others who may wish to come in to get the decision of the Supreme court of Illinois set aside, claiming that the suit in which that decision was rendered did not state the actual facts on which the stockholders' liability is based, but was collusive and fraudulent, and ought not to have been allowed. An assessment of 2 per cent. is the amount required of all who wish to derive any benefit from the pending legislation. G. B. Hawley, a member of the law firm of Tenney, Bashford & Tenney of Chicago, is now in the

city looking up the matter on behalf of the subscribers to the stock. C.

WICHITA, Kan., Oct 20.—A charter has been granted the Citizens' Electric Light company. The capital stock is $10,000 and the directors are George H. Blackwilder, H. C. Sluss, John O. Davidson, C. E. Jackson and Charles D. Duston. B.

KANSAS CITY, Kan., Oct. 20.—The West Side Electric Railway company has been granted an extension of six months for the completion of its road necessitated by the delay in letting the contract and the approach of winter.

Charles Grover, who has been representing the Hawkeye Electric Light company of Oskaloosa, Ia., at Kansas City, Mo., has accepted the position of manager of the Kansas City, Kan., electric light works. E.

BAXTER SPRINGS, Kan., Oct. 18.—The Baxter Springs Electric Light & Power company has filed articles of association with the secretary of state. The capital stock is $20,000. The directors are Alexander Warner of Pomfret, Conn.; Edward L. Warner of Woodstock, Conn., and W. L. Trowbridge, Benjamin S. Warner and H. R. Crowell of Baxter Springs. P.

State of Iowa.

DES MOINES, Ia., Oct. 19.—The Des Moines Gas company has about fully surrendered to the superiority of electricity as a means of illumination. It is now running 300 arc lights, and proposes to establish a 1,000 light alternating system.

It is rumored that there is soon to be a change in the management of the Edison Electric Light company here.

Work on the electric road is progressing rapidly, and it is thought that the Thomson-Houston company will have it completed by the first week in November.

The central station of the Des Moines Electric Light company is a great attraction to all visitors, and especially those interested in electrical matters. All pronounce it one of the finest in the country. Visitors are particularly struck by its clean, polished appearance. As one of them expressed it, "It looks as if it was all the time on exhibition."

Smith Harger, the contractor for the Forest avenue brick paving, states that the laying of the brick will commence on Monday morning. The electric railroad, which already has a charter from the North Des Moines council, will lay its track the whole length of the avenue at the same time it is being paved. F.

OSKALOOSA, Ia., Oct. 19.—The Hawkeye Electric Light company is running under high pressure, and reports great prosperity. It has heavy orders from Montezuma, Storm Lake, Davenport and Kansas City, Mo. The latter order is for a plant of 400 light capacity for the new Baltimore block. It is supplying Davenport with a number of motors. K.

OTTUMWA, Ia., Oct. 19.—The electric light company here has lost the contract for lighting the city, the council having granted the contract for this next year to the gas company. The electric light company is not checked by this action, however, but is going right ahead increasing its incandescent plant.

The Ottumwa Iron works has established an electric light plant of its own of a capacity of 300 lights. It was installed by the Hawkeye Electric Light company of Oskaloosa, Ia. J.

St. Louis, Mo.

ST. LOUIS, Mo., Oct. 18.—The St. Louis Electric Power company occupies the building corner of Third and Locust streets. The plant consists of a Westinghouse and an Ide engine of 100 horse power and 40 horse power respectively The steam is supplied by 2 48 inch by 18 foot boilers, burning slack. The Westinghouse engine drives two Edison 110 volt dynamos of 275 amperes capacity running in series at 4 amperes per horse power. These two machines give about 68¾ horse power. The Ide engine drives one Edison 220 volt dynamo of 136 amperes capacity, which gives an additional 34 horse power, making a total of 102¾ actual horse power capacity. The company supply current for thirty motors, with an aggregate of 130 horse power. They have one 20 horse power motor on their circuits. This company sell the motors outright and furnish the current for so much horse power capacity of the motor per year. This price varies with the business. The St. Louis Electric Power company are agents for the Sprague Electric Motor & Railway company, and have secured several large contracts for the latter company.

Eli S. Sanderson of the National Carbon company, Cleveland, has been in the city for the past few days.

At a visit to the station of the St. Louis Thomson-Houston company last week your correspondent saw their electrician, Mr. Dean, using a voltmeter in adjusting lamps. It seems to be an excellent way to get all the arcs of the same resistance. The neglect to use some instrument of this kind, Mr. Dean thinks, is the cause of so many weak dynamos in this country, as the tendency is to make the arcs a little long. Mr. Dean pointed out a 35 light machine running 40 lamps. This machine has an armature in the rewinding of which is a specimen of his handiwork.

The St. Louis Western Electric company will put in a new switch board of 50 spring jacks. The Western Electric company of Chicago will furnish it. B.

From Montgomery, Ala.

MONTGOMERY, Ala., Oct. 18.—The Western Union moved into its new quarters Oct. 1. The present offices are all that could be desired. When the office was moved to the quarters just vacated, its outfit consisted of eight sets of single working instruments, twenty wires entering the building, and the work was performed by six operators. In the new office, the outfit consists of twenty-four sets of single working instruments, five sets of automatic repeating instruments, three sets of duplex, six sets of quadruplex, with sixty-six wires entering the building, and a force of thirteen experienced operators. The arrangement of the interior was under the personal supervision of Col. J. F. Fenn, chief electrician of the southern division, which comprises all the territory south of the Ohio River and east of the Mississippi, and part of the state of Texas. Col. Fenn has given the Montgomery office his whole time for the past two or three weeks, and will remain in this city for several days longer, and will go to Atlanta where he will fit up the office in that city.

The increase in the Montgomery office in the business department has shown a healthy growth for the past twenty years. The officials say there has been no boom, but it has been steady all the time, and shows that the business of the city has been growing gradually and safely. In the matter of growth of business, Col. Fenn said that Montgomery had been exceeded by no city of the south, with the possible exception of Atlanta.

In point of completeness in equipment in detail, the Montgomery office has not a superior in the United States, and no office in Europe will equal it. Not a little credit is due to Manager Edgar Winter for the present efficiency of the office. W.

South Omaha, Neb.

SOUTH OMAHA, Neb., Oct. 18.—At a meeting of the Electric Power & Light company last week 120 of the 250 shares of stock were reported taken. The capital stock is $25,000, divided in shares of $100 each, and all is owned by citizens of South Omaha. The charter has been filed with the county clerk and with the secretary of state. The $10,000 bond required by the franchise ordinance, signed by the officers and directors, was filed yesterday with the city clerk. The officers are: President, John F. Boyd; vice-president, C. M. Hunt; secretary, John Doe; treasurer, H. C. Bostwick; board of directors, David Anderson, John Doe. D. L. Holmes, C. M. Hunt, H. H. Meday, Joseph T. Smith and A. J. Baldwin. Joseph T. Smith will be superintendent The plant will be located opposite Hammond's packing house on O street and the Union Pacific railroad tracks.

The Western Traffic association is putting in a set of electric scales on the banks of Lake Pivonka, west of the Union Pacific depot. When ready for use all stock yards shipments will be weighed. M.

Missouri Towns.

RICHMOND, Mo., Oct 20.—The Richmond Coal company is constructing a telephone line from this city to Camden There is talk among the citizens of making an effort to establish an exchange here, and it is thought enough subscribers can be obtained. N.

ST. JOSEPH, Mo., Oct. 20.—Representatives of the Electric Light & Power company have been east making arrangements for the installation of a 10,000 light Westinghouse plant.

The Western Engineering company of Lincoln, Neb., is putting a 30 light incandescent plant in the court house. It is of the Mather system,

This city has a new electric fire alarm system. A.

Red Oak, Ia

RED OAK, Ia., Oct. 19.—This city is soon to be lighted by electric light. V. Heinrichs & Co. of Carroll, Ia., have secured from the city council a franchise permitting them to install an Edison incandescent electric light plant. The station will be in operation in less than six months. The city will take 50 lamps at first. The city will furnish the firm with free water for fifteen years, and will donat ground for a station. The firm will furnish 16 candle power lamps at $1.25 per month, and arc lamps for $1 per month on the short hour rate. E.

THE ELECTRIC LIGHT.

The Brush Electric Light company of Buffalo has added 25 arc lamps to its plant.

In Brooklyn, N. Y., the patrol wagons are now being lighted by storage batteries.

The capacity of plant of the Millersburg O. Electric Light company is to be doubled.

The Schuyler Electric Light company of Mt. Vernon, O., started up with 130 arc lights, October 1st.

The Brush Electric company of Baltimore has recently made an addition to its plant of 25 Brush arc lights.

The Wilmington, N. C., City Electric company is putting in a 200 horse power engine and dynamos for 2,500 lights.

One of the new incandescent dynamos of the Van Depoele company will hereafter be employed in illuminating the shops.

The Minnesota Brush Electric company of Minneapolis has recently purchased a number 8 65 light Brush machine and current regulator.

P. V. Dwyer & Bros. have been awarded the contract for the chandeliers and electric light fixtures for the St. Paul, Minn., court house.

The Tennessee Coal, Iron and Railroad company will, it is stated, erect an electric light plant and also build 200 houses at Ensley City, Ala.

At a recent meeting of the Wilmington, Del., city council, the electric light company of that city was given the contract for lighting the streets.

The incandescent lighting system removes nearly all the dangers attending the artificial illumination of places containing gas, says an exchange.

Ten arc lamps have just been shipped by the Brush Electric company of Cleveland to the Albany Electric Illuminating company, Albany, N. Y.

Isaiah Linton has been granted an electric light franchise for the village of Ravenna, O. He will furnish the residents with light, heat and power.

The Troy Silvey Electric Light & Power company of Troy, O., has been incorporated by George D. Ryder and others. The capital stock is $15,000.

The Alton, Ill., Gas & Electric Light company has been incorporated. Capital stock, $60,000; incorporators, Alva E. Campbell, John Watt, Levi Davis, jr.

G. Prigge, Ph. D., superintendent of the Ocala, Fla., Electric Light & Power company, writes that he has succeeded in producing a carbon that will last 151 hours.

The Electrical Construction company of Chicago will install a 400 light incandescent plant in the mills of the Kirby-Carpenter company, Menominee, Mich. Storage batteries will be used in connection.

C. H. Phinizy, C. H. Oetjen and Frank E. Fleming of Augusta and others, have formed the Thomson-Houston Electric company, to erect an electric light plant at Augusta, Ga. The capital stock is $50,000, paid in.

The Kankakee, Ill., Electric company has decided to move its plant from the waterworks, one and a half miles from that city, to the center of the lighting district. The company will discontinue the use of the old machinery and dynamos and erect an entirely new plant, which it expects to have in operation in sixty days.

A writer in the London *Times*, in commenting on the Whitechapel murders, says: "It was estimated in New York that every street electric lamp saved one policeman, and was less expensive to maintain. If every street were well lighted, and every court and alley were brilliantly lighted, deeds of darkness would be diminished and morality promoted."

It is stated that the new Burg theater at Vienna is the best lighted, best ventilated and safest theater in the world. The house is lighted by 5,000 incandescent lights. All over the theater are distributed at small intervals red lanterns holding wax candles which are long enough to last through the evening, and which are sufficient to give light in case the electric light should by any chance be extinguished.

Finally declining to go into an elaborate controversy over electric lighting with ex-Gov. Cornell, Mayor Hewitt of New York writes: "I can only say that every man has his limitations. I am conscious of my own lack of ability to take in the whole compass of human enterprise, and I am compelled to confine myself to the consideration of such matters as are brought before me day by day, and to decide such questions as I am compelled to answer, according to the best of my judgment. This duty I have performed, and shall continue to perform to the end of my term; but I have no time to discuss with you or any one else matters which I do not understand, and have not time to study."

The Louisiana Electric Light & Power company has brought suit against the city of New Orleans for $40,000 damages, and also an injunction restraining the city from paying any money out of the sum appropriated in the budget of 1888 until the claim of the petitioner has been settled. The injunction proceedings have reference to the payment of $1,034.26, from the appropriation for electric lights to the relief of the sufferers from the late overflow. The amount was deducted for lights reported not burning. In the suit for damages the petitioner alleges that it was the duty of the city to remove all dead wires and rotten telephone and telegraph poles, but it failed to do so. In consequence of this failure, during the storm of August 20th, a number of these poles and wires were blown down on the electric light wires of the company, causing the wires to

"ground" and burn out the company's dynamos, causing a suspension of business and consequent damages to the petitioner.

A Baltimore dispatch, dated October 14, says: James Haslip, a lineman in the employ of the Brush Electric Light company, was killed to-night while repairing a lamp on Lexington street. The back of his right hand came in contact with the current in some manner, and his death was instantaneous. He leaves a wife and two children.

The cause of brushes wearing rapidly is often due to the nature of the brush itself, when the fault is thought to be in the armature, says the London *Electrical Engineer*. The more points of contact, the less sparking is the rule. If, therefore, a dynamo sparks, or the commutator burns away, try the substitution of brushes made of finer wire, or of wire gauze. Cases have been known where the brushes have worn two or three times as long, and the commutator kept perfectly smooth by substitution of fine wire brushes in place of those of the copper ribbon type.

The Montezuma Electric Light & Power company of Montezuma, Iowa, has closed a contract with the Hawkeye Electric Manufacturing company of Oskaloosa, Ia. for a 400-light incandescent plant of the Thone system. The contract is to be completed and in operation by November 6th. There will be one circuit for the street lamps and one for the private consumers. The city will be lighted by eight lamps of thirty-two candle power, and twenty-six lamps of sixteen candle power. The engine and boiler contract has been awarded to the Buckeye Engine company of Salem, O.

THE ELECTRIC MOTOR.

The Rutland, Vt., Street Railway company is considering the advisability of using electric motors.

President Ives of the Fair Haven & Westville Horse Railroad company, New Haven, Conn., says he hopes to have all the cars on the road running by electricity within six months.

In speaking of motors the London *Electrical Engineer* says: One can hardly invent applications faster than we hear of the motors being applied to the purposes thought of. Central power supply is the coming boom.

The Grand River Coal & Coke company is putting in an electric plant at Glenwood, Col., to work with water under a head of 470 feet, and proposes to transmit power to its coke ovens, three miles distant. The company has fifty ovens, and is building fifty more.

Five thousand people traveled last Sunday over the electric railway which runs out to the Soldiers' Home, in Washington. The road began operations last week, and it has only four cars. It is operated by the overhead wire system. The experimental operation of the road has thus far been successful.

The Des Moines Electric Street Railway company and the Narrow Gauge Street Car company both desire to lay tracks in Des Moines on Walnut street. The property owners object to double tracks. The matter came up at the meeting of the city council October 9, but no action was taken. The matter was left in such shape that the citizens and the companies will have to work out a solution as best they may.

The Boston *Advertiser* is responsible for the following: Evidently mindful of the ancient fact that lightning splits trees, W. E. Hathaway of New Bedford, Mass., has introduced into his woodyard service an ingenious contrivance consisting of a knife attached to a heavy vertical bar, which at its upper end is fastened to an eccentric in turn connected to shafting driven by an electric motor. By means of Mr. Hathaway's invention, sawed wood is split faster than four men could do with an axe.

A heavy copper wire was laid on wooden supports along both tracks of the Ninth avenue elevated railroad, between Fourteenth and Fiftieth streets, New York, over a year ago. It was announced then that electric motors were to be tried at once on the line. Work was apparently dropped, however, until last week, when a motor ready for business was put upon the third track at Fourteenth street. It is not unlike an ordinary steam motor in appearance, except that it has no boiler or smoke stack The copper wire will have to be fixed up at places where it has been damaged by a year's neglect, and then the motor will probably begin to move. It is made by the Daft company.

The few who have devoted any thought to the subject have undoubtedly formed a very high opinion as to the enormous development that awaits electrical engineering in the way of distributing power, says the London *Electrical Review*. We are convinced that far too little attention has been paid to the subject, and that the glamour of electric lighting has prevented action in a direction that seems to be far less hazardous or risky so far as return for expenditure is concerned. No doubt the subject of electric traction has received a fair amount of attention, and in discussions at societies' meetings the importance of "leveling output" has been shown. But, as a matter of fact, it becomes questionable whether electric lighting will not rather be a by product, than the primary object of central stations.

The residents on St. Charles avenue, New Orleans, are anxious for the construction of an electric railway They presented the matter to Mayor Shakspeare recently, and asked him to veto an ordinance giving the exclusive right to use electric motors to any company. The spokesman made this statement: "We have no interest in the Carrollton Railroad company nor in the Sprague motor. We are only citizens who desire and ask of their representatives, the public servants, the quickest safe means of transportation from our residences to our places of business. The evidence is overwhelming that the Sprague electric motor is both safe and quick. It is in successful operation in twenty cities over 150 miles of street railway. There are already a great many wires—telephone, telegraph and electric light—along St. Charles avenue, and one additional wire would be no objection. If any one objects to an additional row of posts, which most of the property owners do not object to, let an ordinance be passed prohibiting more than one row of posts on St. Charles avenue for carrying electric wires after January 1, 1889; and compel the telephone, electric light, telegraph and railroad companies to unite and hang all their wires on one set of posts. We beg to call your attention to the fact that for nearly three months the application of the Carrollton Railroad company has been before the council; yet the committee on streets and landings has made no report on it. A number of citizens and property owners on the avenue waited on the committee and asked early and favorable action before the recess of the council. A petition signed by a great number of owners of property on and near St. Charles avenue has been presented, asking that this privilege be granted to the company, all without avail so far." The mayor took the matter under advisement.

A description of the storage battery street railway at Paris is given in the following extract: The current is furnished by a battery of 144 special twin-plate Faure-Sellon-Volckmar accumulators, having a capacity of 150 ampere hours, with a 25 ampere discharge. Taking the mean useful voltage per cell at 1.8 volt, the total capacity of the battery is 37,000 watt hours, or 50 horse power-hours—that is to say, 40 horse power-hours are practically available, permitting a 6 hour service without recharging. The accumulators are placed in the four recesses formed by the corners of the car, the 36 cells in each group being arranged in three tiers. This vertical disposition has several drawbacks: it adds to the length of the car, renders the inspection and manipulation of the cells very difficult, and dangerously raises the center of gravity. In the new cars the cells will probably be arranged in two rows under the seats. The total weight of car with 50 passengers is about 9 tons. For purposes of alteration of speed and starting, the accumulators are divided into four groups. On starting the four groups are in parallel, and there is an available e. m. f. of about 70 volts. When running at full speed all the cells are in series. The sections can also be grouped by the turning of a lever, two in series and two in parallel, as well as three in series and the fourth section in parallel with these. The car is of course lighted by electricity, six 10 candle power incandescent lamps being run off the accumulators.

THE TELEPHONE.

The Wilmington, Delaware, *News* states that a telephone wire has been erected from the Lewes life station to the station at Chincoteague. Through the communication thus established, many lives can be saved in case of a disaster.

The telephone was put to a novel use in Toronto. A citizen who had been summoned to appear at the police court for breach of a by-law, finding that he would be unable to appear in person, telephoned the fact to headquarters, admitting his guilt, and was fined $1 and costs through the same medium.

In the United States Supreme court, October 15th, the decision in the lower court in the case of Rogers, of Pan-Electric telephone fame, against Attorney General Garland, Gen. Joseph E. Johnston, ex-Congressman Casey Young and others was reversed, and the court directed the defendants to render an account of the moneys and stock received as officers in the Pan-Electric Telephone company.

During the prevalence of the yellow fever in Jacksonville, Fla., the telephone service has been uninterrupted. Six of the ten employes there have had the fever and recovered. The exchange at Decatur, Ala., has been closed, the building in which the central office was located having been taken by the Board of Health for an hospital. The manager, Benjamin Grant, was directed by the physician of the Board of Health to leave town, as he was a Northern man. While on the way to his former home at Newark, O., he was attacked with the fever and obliged to be taken from the train at Louisville, Ky., and placed in an hospital there, where he died on the 28th ult. He was a promising young man 26 years of age, and was married in June last.

The new rooms of the Board of Education at New Haven are not a telephone exchange, but the telephone connections with several of the school buildings are made by means of a switch board, says the New Haven, Conn., *Register*. There are fifteen plugs, eight of which are now in use. Any of the school buildings having telephone connections can be called up without the aid of the central telephone office. Plug number 1 calls the central telephone office, and this wire is used in talking about the city. Plug number 2 connects with the high school building. Number 3 is the Eaton wire. Number 4 the Washington and Cedar. If it be desired to talk with the Washington school building, number 4 wire is connected, and one signal is given. If the Cedar school house be wanted two bells are sounded, and three signals for the Welch school. Number 6 is the Winchester and Shelton avenue wire, one signal being for Winchester and two for Shelton avenue. Number 7 is the Woolsey and Hamilton school wires; one bell calls Woolsey and two calls the Hamilton building. Plug number 8 is for Dwight school; number 9, Wooster; number 12, Skinner. The new Rosette street school house will soon be placed in connection, and the wires not in use can be connected with other schoolhouses, as required The switch board proves a great convenience over the old method of calling the central office when any of the school houses are wanted The superintendent and secretary can, by means of the wires, accomplish a vast amount of work. The wires particularly convenient in promptly supplying substitute teachers at schools where there are temporary absences.

THE TELEGRAPH.

The Subway board of New York received several complaints last week from companies using the subways in lower Broadway that their cables had been ruined by heat from the steam company's pipes. The Western Union company reported that 400 of its wires had been rendered useless, and asked for a permit to run overhead cables from the Western Union building to the exchanges to replace the ruined wires.

A dispatch from Findlay, O., dated October 17, says: The Cushman Telephone company of Chicago has been operating an exchange in this city for the last year and a half, notwithstanding the Bell company has been harassing them with suits of all kinds for alleged infringements of the Bell rights and privileges. To-day, however, the Cushman company gave up the fight and sold its entire plant to the Bell Telephone company, which will hereafter operate the exchange with Bell instruments and at higher rates than the old company charged.

A dispatch from New York, dated October 10, says the annual meeting of the Western Union was held at noon today. President Green presented the annual report. The board of directors was chosen. Six hundred and sixty-three thousand shares were represented. Last year's board was re-elected with the exception of Abraham R. Van Nest, deceased. His place was filled by Henry M. Flagler, representing the Standard Oil company. The annual report for the year ending June 30 shows gross earnings of $10,711,168; expenses, $14,640,592; net earnings, $5,070,571; payments on dividend, interest, and sinking fund account were $4,574,208, leaving a surplus of $496,363.

A dispatch dated Oct. 5th., from Laramie City, W. T., says: In the district court of Albany county, this afternoon, Dilks Black, manager of the Western Union Telegraph office at this point, was fined $100 and committed to jail until 10 o'clock to-morrow morning for failure to produce certain telegrams, as directed by Judge Saufley. A few weeks ago Edward J. Wagner, an extensive clothier of Laramie, gave a bill of sale on his stock to his brother, Charles Wagner of St. Louis. Several creditors then secured attachments on the stock, on the ground that the transfer had been made to defraud them. Mr. Black, as manager of the Western Union, was commanded to produce all the telegrams that had passed between the Wagners, but upon the advice of General Superintendent Dickey he refused to do so. Mr. Dickey telegraphed Mr. Black late this afternoon to stand firm, as the company proposed making a test case of it. In committing Mr. Black Judge Saufley simply said: "We will see which has the greater power, the Western Union Telegraph company or the congress of the United States. Mr. Clerk, enter up a fine of $100 against Mr. Black, and, Mr. Sheriff, commit him to jail until 10 o'clock to-morrow morning. There is to be no parole about this business, but he is to remain in jail until his fine is paid."

A railroad telegrapher recently said: "Ours is a profession that tries men's souls. Notwithstanding that in late years the different railways have adopted rules which thoroughly systematize the business, even with all the safeguards, a little bit of carelessness or dereliction of duty is liable to cause trouble, and not only loss of property, but in many instances is attended with loss of life. I remember some years ago when I had charge of trains on a Southern road, where telegraph offices were few and far between, of giving an order to the operator at a certain station to hold the north-bound passenger train for orders, so that I might help the south-bound passenger train to make its meeting point, the latter being somewhat late. The operator repeated the holding order, for which I gave him O K. I then gave the south-bound train an order to use some of the north bound train's time to make the meeting point. Instead of holding the north-bound train for orders the operator let it go by him. The road was crooked, and as both trains were between telegraph stations, I started to walk the floor and wait until I should hear of their coming together. The suspense was terrible, almost unfitting me for my other duties. As good luck would have it, the north-bound train, which had undisputed right of the road, was delayed before reaching the meeting point. When the first train reached a telegraph station I felt relieved, but the strain had been so terrible on my nerves that I was not good for much for several days, and the experience of that morning will ever remain in my mind."

Charles W. Brega has filed a bill in the Circuit court at Chicago to have the lease of the Board of Trade Telegraph company to the Postal Telegraph Cable company set aside on the alleged ground of fraud. E I Stokes of the Hoffman House, New York, L. D. Parker, Dwight Townsend, Henry A Gardner, Frank Gilbert, the Board of Trade Telegraph company, the United Lines Telegraph company and the Postal Telegraph Cable company, are made defendants to the suit. Mr. Brega is a member of the Chicago Board of Trade. He charges that Stokes, Parker, Townsend, and Gilbert, having a controlling share of the United Lines company, which included the Board of Trade company, the Rapid Telegraph company, and the Bankers' and Merchants' Telegraph company, secured a questionable title to 475 shares of the stock of the Board of Trade company, and that Stokes elected himself, Parker, Gilbert and Townsend directors, and as an executive committee leased the Board of Trade company to the Postal Telegraph Cable company at an annual rental of $5,000. Brega charges that this executive committee has no power to make such a lease; that the figure is ridiculously low, and was permitted by Stokes for the purpose of depressing the Board of Trade Telegraph company's stock and freezing out the defendants and ignoring the claim of the Farmers' Loan & Trust company to 377 shares of the stock. At the stockholders' meeting Brega, Ball and others voted against Stokes, but were unable to check his plans. Brega prays in his suit that the lease be annulled; that the Cable company account for and pay the actual

value of the use of the plant since 1886, to be distributed as dividends, and that a receiver be appointed for the Board of Trade company to prevent its absorption for less than its real value by Stokes.

Personal Paragraphs.

Elmer G. Willyoung, representing James W. Queen & Co. of Philadelphia, spent a few days in Chicago last week.

Osgood S. Wiley of Orange, N. J., one of Edison's assistants, has gone to England to open an office there for the exhibition of the Edison patents.

Theo. P. Bailey, manager of the railway department of the Thomson-Houston company was in Washington ast week in attendance at the street car convention.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	340	345
Central Union	47	48
Michigan	81	82
Great Southern	34	37
Colorado	43	46
Rocky Mountain Bell	41	43
Cumberland	68	70
Wisconsin	116	118
Bell of Missouri	150	155
Iowa Union	28	29
Missouri and Kansas	70	71

Miscellaneous Notes.

Chicago was visited by a storm of unusual violence, October 18th. Lightning struck in several places, but occasioned but little damage.

The Sprague Electric Railway & Motor company was represented at the convention of the American street Railway Association at Washington, last week by H. McL. Harding, F. J. Sprague, A. H. Chalbonne and William Hazleton.

The lightning struck in the roadway at the crossing on Bowling Green, New York, last week, tore a ragged hole in the earth, and chased along the subway trenches under the pavement. Inspector Richmond of the subway found the wires unharmed.

The New York Water & Electric Supply company, limited, has been incorporated at Buffalo, with a capital of $15,000, for the purpose of constructing and erecting electric supply plants for public and private use. Robert Palen, Augustus Dowdall and others are interested.

In a paper read before the British Association, Walter T. Glover said: "I feel that the British association for the Advancement of Science may with the greatest advantage to both the scientific and commercial worlds, advance a step by instructing their committee on electrical standards to at once commence a series of definite experiments to determine what is the specific resistance of pure copper."

Charles Birtman, an employe of the Van Depoele company, Chicago, received a severe shock while testing lamps last week. He attempted to lift a lamp out of the hanging wires without throwing it out of circuit. He received the full current from a 60 light arc machine. He was in the circuit, it is said, about two minutes before he was discovered and the current was turned off. He was unconscious for about an hour, when he revived sufficiently to be taken to the county hospital. Three days later he was apparently as well as ever. His hands were badly burned.

In London recently Dr. Waller made an address on his discovery of electrical currents caused by the pulsation of the human heart. The researches which Dr. Waller described have occupied him during the last four years, and the record was interesting, he thought, as an actual example of what goes on in physiological laboratories, and a correction of "that most unfortunate and mischievous error that they are chambers of horrors." In commenting on the address the *Pall Mall Gazette* says: "But more interesting still are the results of the researches themselves for if in each human heart there be, indeed, a latent electrical battery, then developments in the art of electricity may in time become possible, beside which even Mr. Edison's wonderland will seem commonplace."

Mention has been made heretofore of the litigation between W. H. Boulton and the Cleveland Carbon company. The last phase in the complication is a suit instituted by the Standard company against Mr Boulton to obtain $30,000 damages. By reason of Mr. Boulton's acts, it is alleged in the complaint, the works were idle for eight days, thus preventing the making of carbons worth $5,000. It is also charged that Mr. Boulton started a carbon company on his own account under the name of the Boulton Carbon company, intending to injure the plaintiffs' business, and that he caused to be printed and circulated certain false reports, in which it was stated that the plaintiffs owed $32,000, and that they only had $290 with which to pay the same. Mr. Boulton is also charged with giving wide circulation to the statement that the Standard company was in a crippled condition, and that the Boulton company invited the patronage of its former customers. Mr. Boulton is charged with preventing the plaintiffs from taking their letters and correspondence from the postoffice. Mr. Boulton has been enjoined from conducting his business under the name of the Boulton Carbon company, or advertising under that name to the effect that he produces the only reliable Boulton carbon. He gave notice of an appeal to the Circuit court and was given thirty days in which to prepare a bill of exceptions.

Business Mention.

The office of the Loomis Electric Manufacturing company at Boston, Mass., has been removed to the corner of Franklin and Congress streets.

J. H. Shay of the Chas. Munsen Belting company of Chicago returned recently from Baltimore with an order for one 40 inch and two 30 inch double leather belts for the Brush Electric Light company at that place.

The Union Indurated Fiber company of New York is adding so many new lines of goods that a monthly sheet is now issued devoted to novelties. The September sheet shows that many articles of great utility have recently been put on the market.

Shaw & Geary, of 53 North Seventh street, Philadelphia, have built up an extensive business in electric bells and special manufacturing. Some of their specialties were recently illustrated in the WESTERN ELECTRICIAN. Their business is growing rapidly.

The Hartford, Conn., Dynamic company has received from far away Oregon the following tribute to the excellence of the double pole switch, recently described in this journalt "Your sample double pole switch at hand. It is a long ways the best I have seen. Please send more, per inclosed order."

The season has been an unusually busy one for the Electrical Construction company of Chicago. The company has just finished electrical work in the elegant houses of Emil Schandein, Milwaukee; Clem Studebaker, South Bend, Ind.; J. C. Hubinger's, Keokuk, Ia.; and William Larsen, Fort Howard, Wis.

Benson & Thompson, of 3015 Chestnut street, Philadelphia, make a specialty of insulated wires, and their work is excellent. They have a neat and well-arranged shop, and some of the winders and braiders in use by them are of their own devising. Flexible tinsel wire for electroliers is one of their specialties.

The Electrical Supply company of Chicago have special arrangements for furnishing, and carry a large stock of the Stoddard patent combined rosette and cut-out. The principal point of advantage in this cut-out lies in the fact that it is detachable, the rosette and cord being entirely removable for replacing fuses.

The Standard Carbon company of Cleveland, O., is running to its full capacity, and manufacturing about a million and a half carbons a month. The company employs about 150 men and is running four dynamos for copper plating the carbons The company makes forced and molded carbons suitable for any system of electric lighting.

C. B. Curtis, western manager for the Solar Carbon & Manufacturing company of Pittsburgh, is now located at 175 Randolph street, Chicago, where he carries a full line of the well-known solar carbons in stock. Mr. Curtis has built up a fine trade in these goods West, and customers find it a great convenience to be able to get their orders filled from stock carried in Chicago.

The Viaduct Manufacturing company of Baltimore, Md., is making a specialty of a new magneto signal bell, to which it has given the name of "monumental." The name is apropos when applied to the bell in the sense of a bargain to the purchaser, for the bell at the price is a monumental bargain, quality of goods considered. The bell is intended to supersede battery bells for signal purposes.

Those interested in hard rubber electrical supplies should write the Goodrich Hard Rubber company of Akron, O., for their illustrated catalogue, which they will send postpaid upon application. In it are listed sheet, rod, tubing, insulator hooks, battery cells and all staple articles of their manufacture. Any orders, large or small, that are placed with this concern will be promptly and satisfactorily filled.

James W. Queen & Co., of Philadelphia, Pa., have just made an arrangement by which it will be possible to secure in America fine resistances, standard coils, Wheatstone bridges and instruments of like class of as fine if not finer grade than those made by the Elliotts in London, and fully as accurate. The instruments will be made by themselves, and will, of course, have the superior material and workmanship for which this firm is noted, and will be calibrated by Prof. William A. Anthony, who will certify to the accuracy of every instrument passing under his inspection. The same firm has already taken orders for calibrating the finer instruments of electric light companies, and intend to make this a special feature of their business.

The treasurer of a large manufacturing company, wrote Edward Atkinson, president of the Boston Manufacturers' Mutual Fire Insurance company, regarding magnesia sectional steam pipe and boiler covering. He received the following in reply: "We consider the magnesia sectional steam pipe and boiler covering an article of very great valne as a non-conductor, of great convenience in matters of application and change, and furthermore, what pertains more strictly to insurance business, as absolutely incombustible. Several years ago we were forced into making a careful investigation of the merits of the various non-conducting coverings for steam pipes, by reason of numerous fires which had occurred in those substances, and it was found in the course of that work, that many of the mineral substances of high reputed value had but little practical valne as non-conductors. At the same time a number of substances not known to have ever been applied to the protection of steam pipes against radiation were investigated, among them magnesia, and it was found that it possessed a very high protective power in the retention of heat The results of that investigation were published by this company, and also in the transactions of the American Society of Mechanical Engineers. This caused some persons to apply the information contained in that report, and finally resulted in the manufacture of the magnesia sectional steam pipe and boiler covering, which consists of magnesia bonded together with asbestos, and moulded into shapes which will readily fit upon various sizes of pipes and fittings. The asbestos is simply used as an incombustible bond, but does not add to the non-conducting power of the covering, being in itself rather a good conductor of heat when in solid condition. In a fibrous condition it holds entrapped air and therefore prevents the radiation of heat to some extent."

Electrical Patents.

Issued Oct. 16, 1888.

391,010. Electric Meter. Harry Bentz, York, Pa.

391,034. Device for Refining Metallic Ores. Henry H. Eames, Baltimore, Md.

391,070. Dynamo Electric Machine. Myron W. Parrish and William R. Cole, Detroit, Mich.

Elastic conducting plates are employed in contact with the shaft of the armature; these conducting plates are supported above the revolnble shaft, and are provided with pendant guards; the forked conductor is placed between the pendant guards and the straddle of the shaft.

391,114. Safety Attachment for Electric Motors. Charles F. Brush, Cleveland, O.

The invention is designed to be applied to the governor of electro magnetic motors, in which a weight is moved outward by centrifugal force against the action of a retaining spring, the outward movement of the weight being made to close a switch for short-circuiting or cutting out the motor.

The first claim is: "In an electric motor the combination, with a switch, of a radially movable pin or weight connected with the governor casing and adapted to be thrown outward by centrifugal action, and engage the switch lever and close the switch."

391,224. Hand Magneto Electric Machine. John B. Blair, Chicago, Ill.

391,229. Separator for Electric Batteries. Herbert W. Butler, Brixton, County of Surrey, England.

The invention consists in providing a separator of such material and form that the plates or elements of a battery are maintained at the proper distance from each other, while allowing for the proper circulation of the electrolytic fluid. Should any scaling of the plates occur by the use of separators the scales will not come in contact with two adjacent plates or elements of active material.

391,270. Dynamo Electric Generator. Gustav Pfannkuche, Cleveland, O.

The object of the invention is to provide a dynamo electric machine, by means of which currents of continuous direction, made up of successive waves or pulsations, are to produce a dynamo machine which will generate a pulsatory current, the waves or pulsations of which will occur with sufficient rapidity, have sufficient potential, and be of sufficient volume to adapt them to the conditions for which, in any particular case, they are intended.

Claim 3 reads: "The combination to form a pulsatory current dynamo of a multipolar field magnet, composed of a number of poles of alternate and opposite polarity equi distantly disposed around and parallel with the axis of rotation, an armature consisting of a tubular iron shell having radial end flanges, and wound with insulated iron wire to form a cylindrical core, and coils fastened on the exterior of the core, and a rectifying commutator."

391,276 Signaling Device. Julius Sax, Bedford Square, County of Middlesex, England.

The invention relates to an appliance for communicating between the driver and passenger in a cab or other vehicle, or for other purposes of communication.

391,319. Regulation of Electric Motors. Lander S. Harris, Detroit, Mich.

The purpose of the invention is to produce a motor which may be made to run faster or slower without varying the amount of current passing through the fields, and without varying materially, if any, the resistance on the main line, the results being accomplished by a peculiar winding of the machine, whereby the current is shifted through coarser or finer wire, thus producing the magnetic effects necessary to impart to the machine a greater or less speed and power, as it may be desirable to vary the same. The first claim reads: "An electric motor having its field magnet wound with different sizes of wire and means for shifting the entire current from the main line through one or more of said grades of wire at will, thereby varying the speed and energy of the motor."

391,351. Electrical Switch. John S. Adams, Indianapolis, Ind.

The invention relates to that class of switches which are principally used to turn the current on and off electrical lamps. The first claim is as follows: "The combination in an electrical switch of a pivoted switch-bar having two cam-points, a cam-block having corresponding cam-points and a square portion, and springs resting against the sides of said square portion."

391,356. Telephone Transmitter. William H. Collins, Chicago, Ill.

The invention consists essentially in the vibratory diaphragm and its electrode, in combination with the second electrode, which is provided with a recess, filled with mercury. This second electrode is carried upon a yielding support, and is provided with a pin extending into the mercury.

391,364. Galvanic Belt. Edwin D. Granger, St. Louis, Mo.

391,394. Electric Railway System. David G. Weems, Baltimore, Md.

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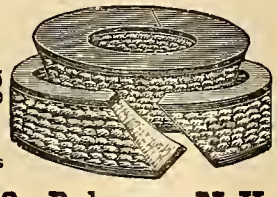

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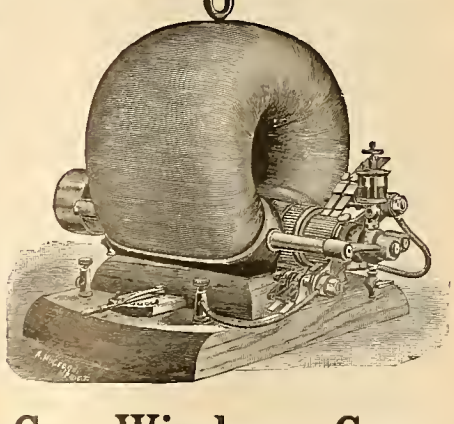

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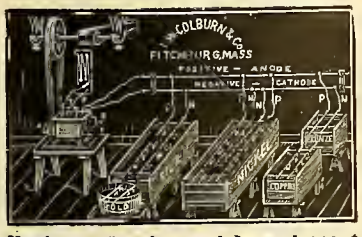

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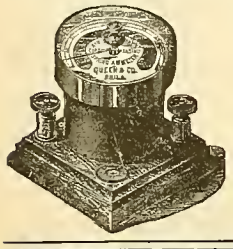

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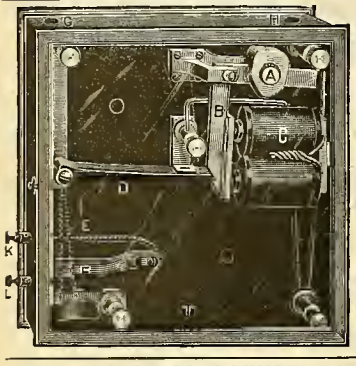

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NATCHEZ, MISS., Aug. 27th, 1888.

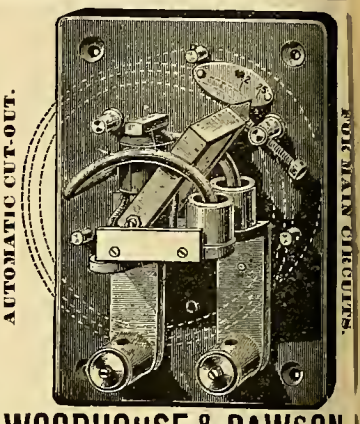
Notice is hereby given that sealed proposals will be received at the office of the City Clerk until **12 o'clock M., November 1st, 1888,** for lighting the streets, alleys, commons or parks of the city, with electricity, in accordance with plans and specifications to be placed in the City Clerk's office, for the period of five years, that is to say, that portion of the city now lighted with gas, from the 1st day of March, A. D., 1889, and that part lighted by coal oil lamps, from the 1st day of June, A. D., 1889.

Each bidder is required to file with his bid a detailed statement of the number and location of the plants then in operation, of the particular system which he proposes to establish in Natchez if successful in bidding, and to specify as to each plant so in operation whether it is the one originally established in such locality or has been substituted for some other previously in use, and, if a substitute, then for what system.

The successful bidder will be required to enter into good and sufficient bond, of such penalty as the Mayor and Aldermen shall hereafter fix, conditioned that he will erect and have ready for use the electric plant, and begin the lighting of the city therewith, on the dates herein before stated.

The Mayor and Aldermen reserve the right to reject any or all bids.

W. H. MALLERY,
Mayor of City of Natchez.



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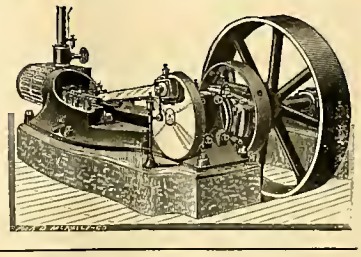

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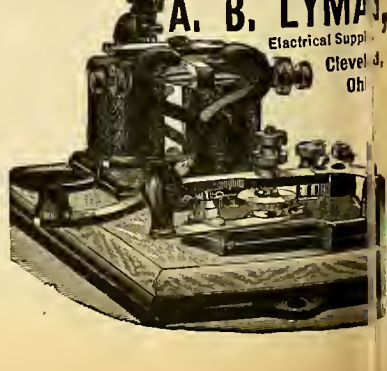

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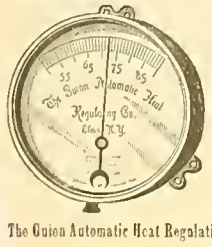

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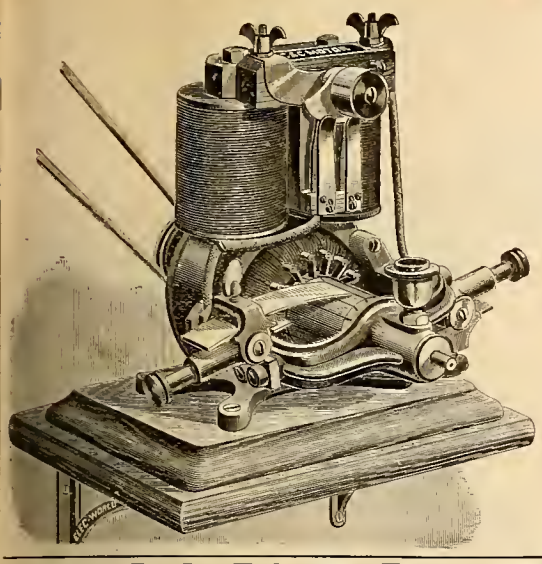

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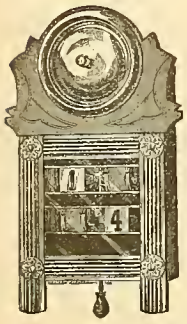

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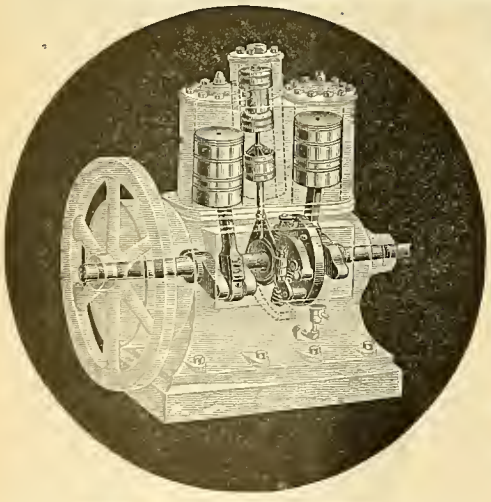

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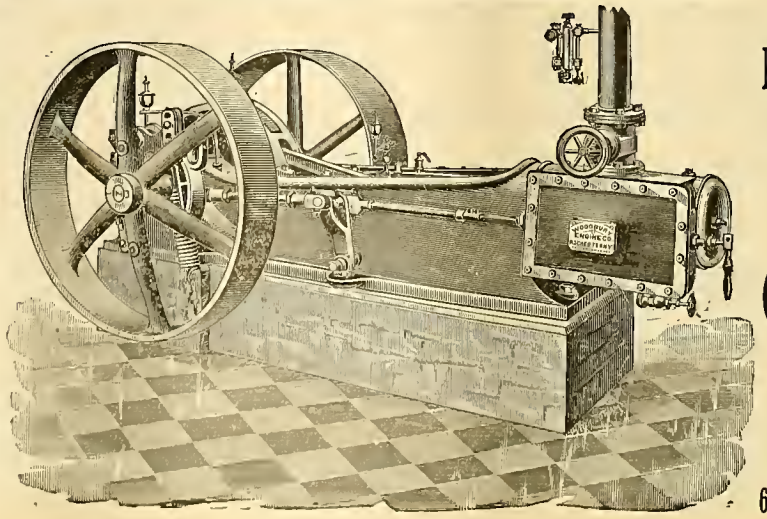

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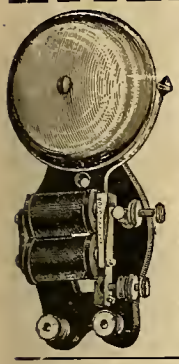

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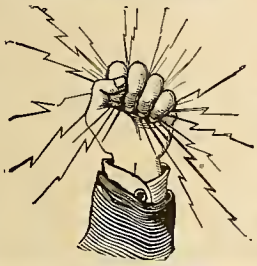

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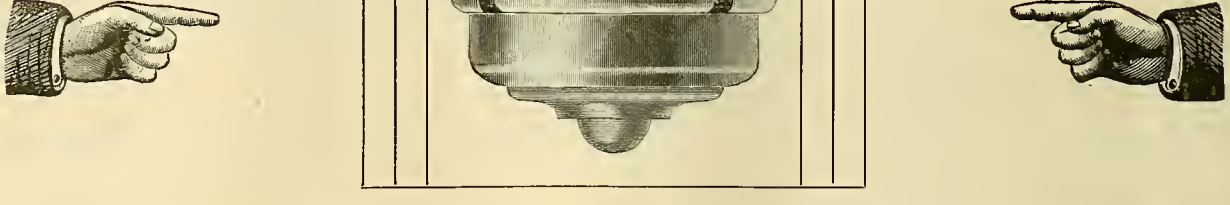

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Trade No. 872 for Moulding Work.
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Trade No. 875 for Three Wire Work.

We have special arrangements for supplying these. A large stock is constantly on hand.

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(Patented Jan. 10, 1888.)

FOR RELIABILITY OF ACTION, PERFECTION OF WORKMANSHIP,

ELEGANCE OF FINISH, EXCEL ALL COMPETITORS.

Style A.

Style A 1

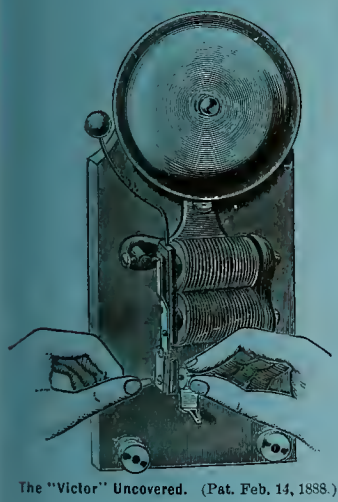
Style A 3

These illustrations represent our styles "A," "A 1" and "A 3," the last recently designed and brought out to meet the demand for an instrument less expensive than our elegant style "A." The style "A 1" is particularly neat and well finished. The style "A 3" is of handsome design, and we venture to say better finished than any other cheap Annunciator on the market, while the works in both styles are of the celebrated "Tirrell" Gravity Drop pattern, the same as used in our highest priced machines, all of which contain many recent improvements.

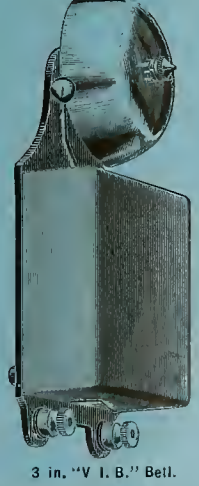
By an ingenious and practical arrangement, the style "A" Gravity Drop Annunciator is converted into a Burglar Alarm, embodying all the advantages of the Annunciator, besides covering every conceivable requirement for burglar alarm use. It is provided with a battery test, silent test, continuous ringing attachment and shunt switches from each section of the system, or the whole, all operated by one battery. Gas-lighting attachment furnished when desired.

THE ELECTRIC GAS LIGHTING CO.

SOME OF OUR ELECTRIC BELLS.

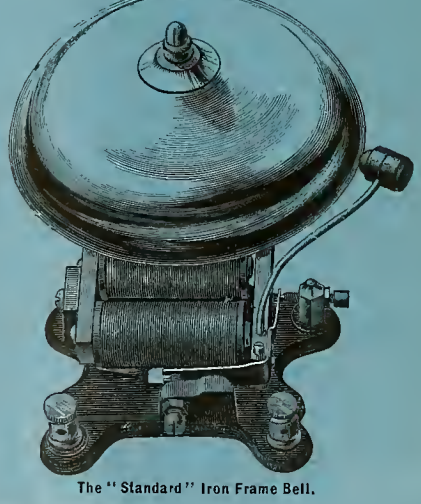


The "Victor" Uncovered. (Pat. Feb. 14, 1888.)



3 in. "V. I. B." Bell.

The "Hub" Bell.



The "Standard" Iron Frame Bell.

THE "VICTOR" WOODEN BOX BELL

Has attained an enormous sale, because it makes friends wherever it goes. Its superiority consists in a **Soft Iron Bed-Plate,** to protect the adjustment from warping of the base-board; a **Double Adjustment** of the tension of spring as well as length of stroke; **A Novel and Convenient Clasping Device,** for fastening the box to base-board· **Platinum Contact Points;** and **Gongs of Superior Tone.**

THE "VICTOR IRON BACK" BELL

Is the same as the "Victor," except that the soft iron bed-plate is made to answer the purpose of a back as well, thus doing away altogether with the wooden base-board. A finely finished wooden box is used, as with the "Victor" Bell.

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Embodies several decidedly novel and practical improvemen'ts, which render it a fit companion to our celebrated "Victor" and "Victor Iron Back" Bells.

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LOUIS W. BURNHAM,
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INCANDESCENT LIGHTING,

—AND THE—

JENNEY SYSTEM

—OF—

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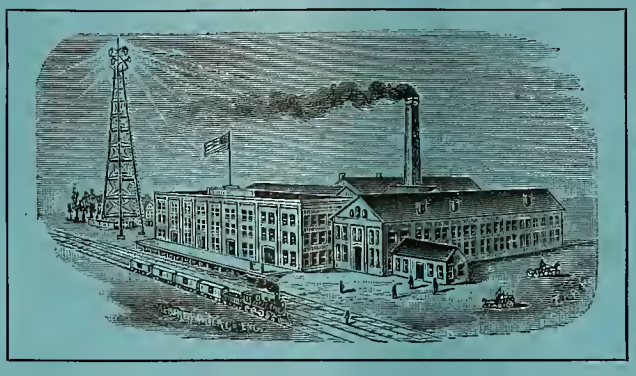

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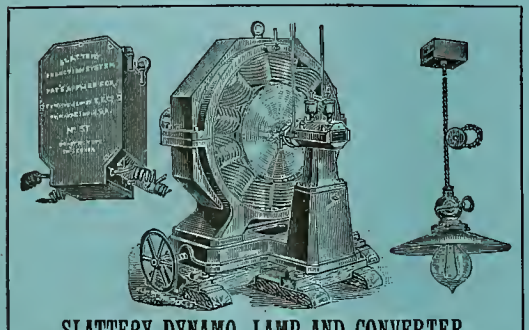

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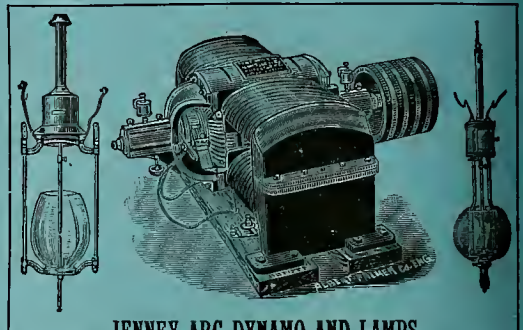
CORRESPONDENCE SOLICITED.



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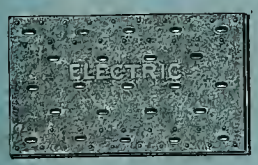

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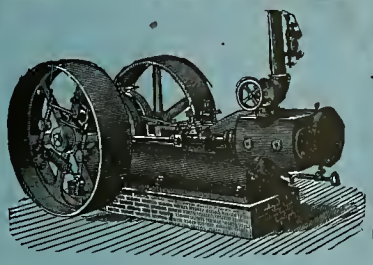

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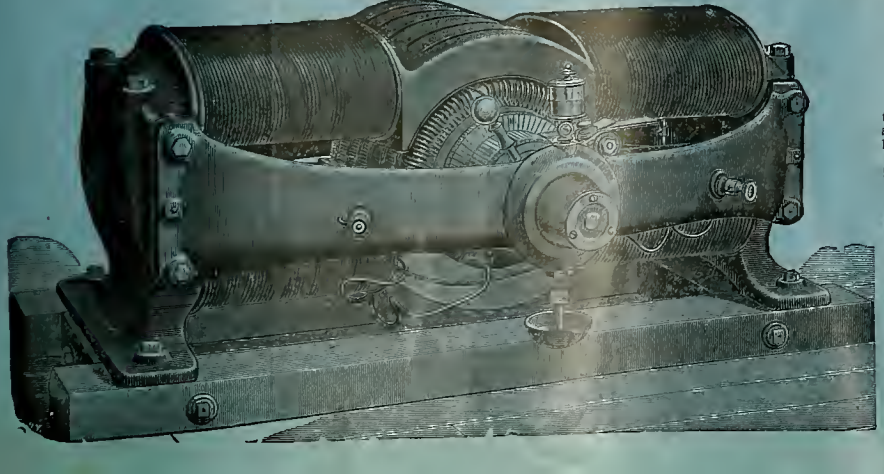

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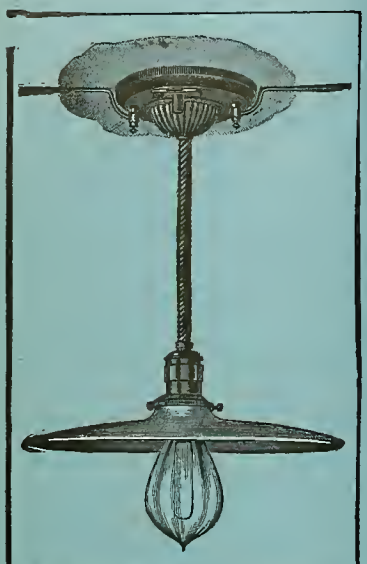

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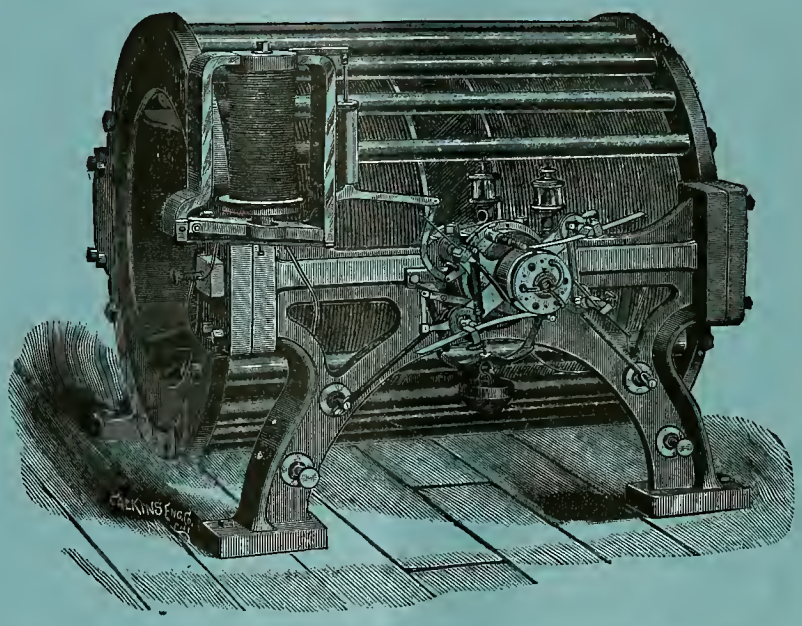

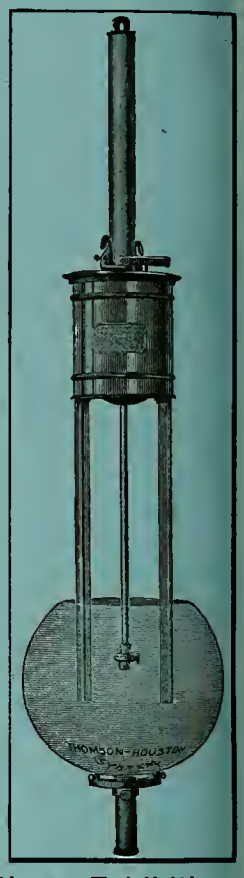

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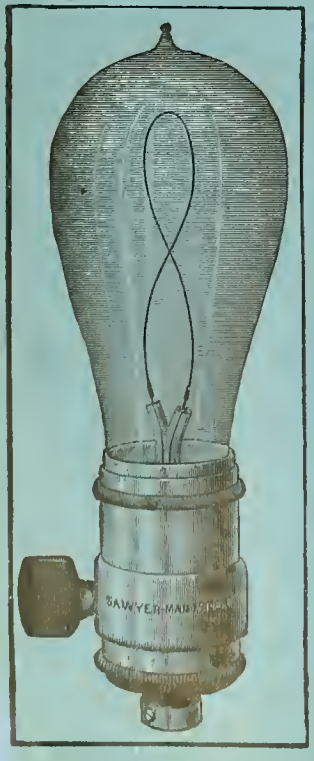

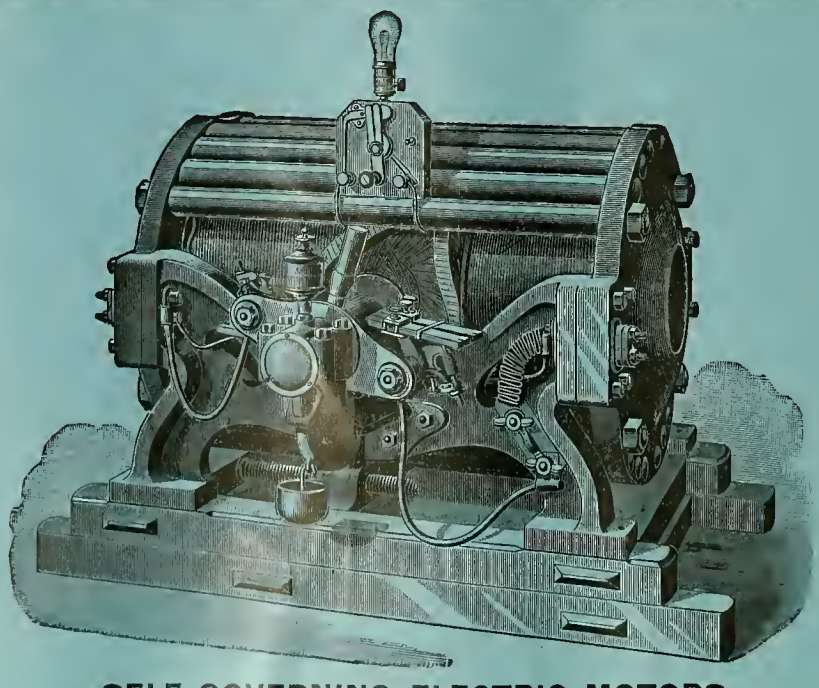

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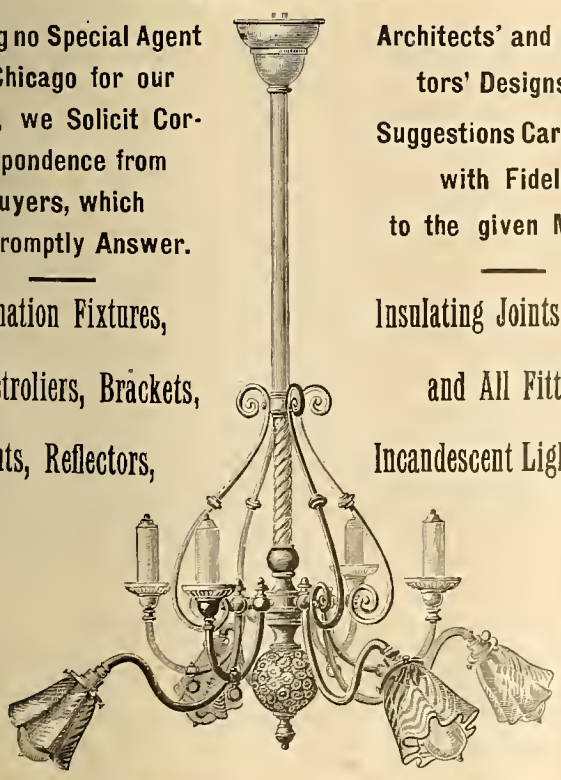

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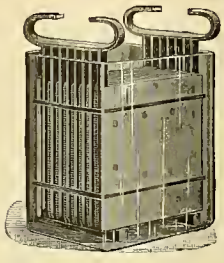

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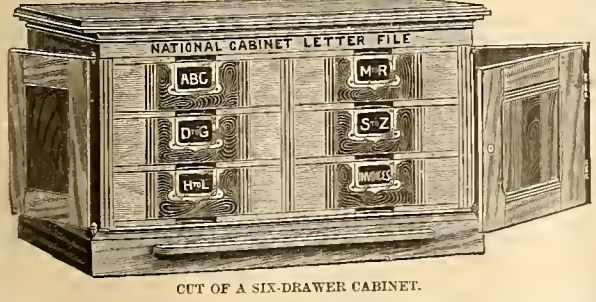

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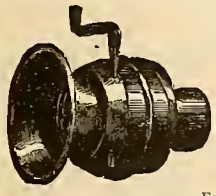

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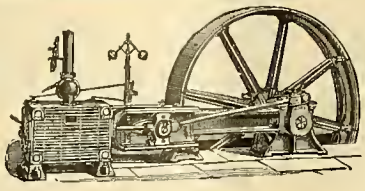

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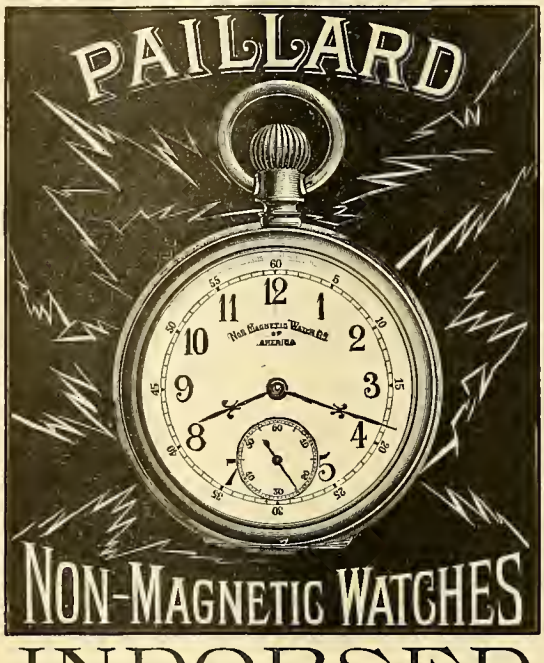

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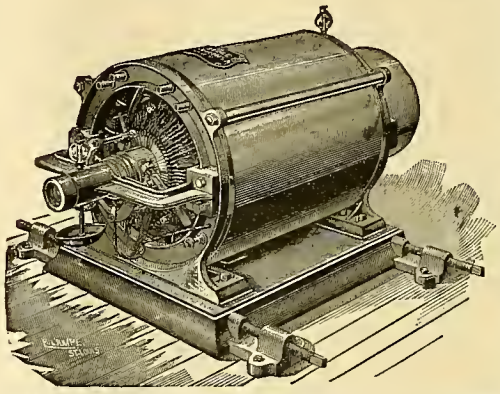

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Western Electrician.

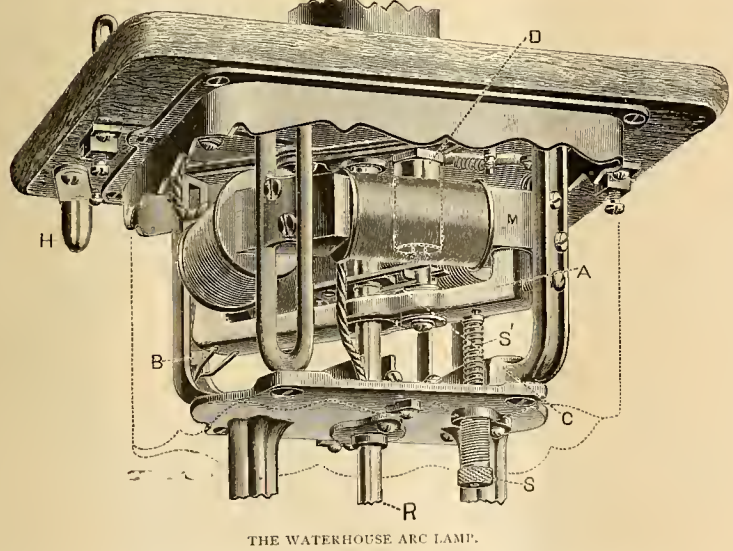
EVERY SATURDAY.

Vol. III. CHICAGO, NOVEMBER 3, 1888. No. 18.

The Waterhouse Arc Lamp.

The essential part of an arc lamp lies in its carbon feeding and regulating mechanism. The accompanying illustration shows very clearly the method employed in the arc lamp of the Waterhouse Electric & Manufacturing company, and its novelty will attract close attention.

Referring to the cut, the magnet M is quadrangular in shape, having two independent circuits wound at right angles to each other, which produces upon the magnet two poles of constant polarity and two poles of variable polarity. Under the variable poles an armature is pivoted and is held in position by the pivot, supports B and spring S^1 when no current is passing through the lamp. Movement to the carbon rod R is imparted by clutch C, which is attached to the armature A. To prevent a sudden upward movement of the armature the air dash pot D is used and the spring S^1 prevents a sudden downward movement of the armature. The resiliency of the spring S^1 is changed by means of the screw S, and it is this adjustment, which is outside the bonnet of the lamp, that regulates the length of the arc, for, by changing the tension of the spring the position of the armature is slightly changed, and the clutch binds the carbon rod R in accordance with the changes in the spring S^1, allowing the carbons to feed at just the proper time.



THE WATERHOUSE ARC LAMP.

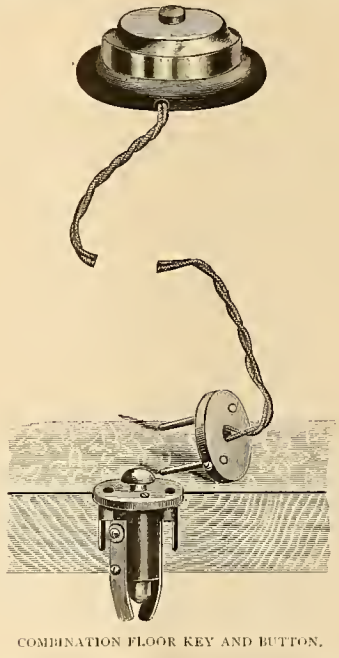
The variable poles as will be seen, become variable in the following manner by changes of the resistance in the arc of the lamp: The current coming to the lamp enters through the terminal near the handle H, passes to the main conductors around the main coils and thence to the carbon rod R through the carbons, and leaves the lamp at the terminal on the opposite side of the lamp board. This produces magnetism in the variable poles of the magnet M, the tongue of the armature A is drawn up into the elongated hole of the magnet, and the movement of the armature binds the clutch to the carbon rod and the arc is formed. So soon as the excess of resistance is greater in the main than in the shunt coils, a portion of the current is diverted through the shunt, neutralizing the magnetism in the variable poles of the magnet, for the magnetism in the variable poles of the magnet is the sum of the difference between the magnetism produced by the shunt and the main coils. The neutralizing effect of the current passing through the shunt coils permits the armature A to recede slightly by gravitation, which eases up on the clutch C and the carbon rod R, which feeds the carbons. On the end of the armature A above the supports B, the surface is rounding; and as the armature is drawn up away from the supports B it is free from any mechanical friction and directly susceptible to changes in the magnetism in the magnet M.

There are but few parts to wear out in this lamp; it is very simple in construction, and the makers claim the usual fine adjustment of arc lamps is not required. The lamp is thoroughly insulated throughout and convenience for easy trimming as well as the small details, have had the careful attention of the makers.

The same form of magnet is used in the Waterhouse rack feed lamps, and also in the double lamps furnished by the company.

Combination Floor Key and Button.

The floor key underneath a dining table in circuit with an electric bell in the kitchen forms a most useful adjunct to every well appointed dining room. Instead of breaking in upon the conversation with the noisy clang of a hand bell, perchance utterly ruining the climax of a good story, or destroying the telling point in a *bon mot*, the mistress, by a simple pressure of the foot upon the floor key, noiselessly, so far as those at the table are concerned, summons the servant to do her bidding, and conducts the affairs of the table quietly, easily, and magically. But the floor key is stationary, while the table is not; and it may chance that at the very time she needs her electric messenger the most, as, for instance, when she entertains a large number of diners, the mistress and the floor key, by a new arrangement of the table, are separated. The contrivance shown in the accompanying illustration, designed and manufactured by the Central Electric company, will then come into play. The floor key is of well-known form, but the round flange is made of fiber instead of brass. When the floor key is in proper relation to the mistress of the house, it is used in the customary way; but when it is necessary for the lady to take another place at the table, the brass connecting pin in the center of the key is removed, and the brass pinions on the disk attached to the cord are inserted in the holes in the disk on the floor, making connection in the floor key. The push button can then be placed on the table whenever desired, and the mistress of the household again has her messenger ready to respond instantly to her command.



COMBINATION FLOOR KEY AND BUTTON.

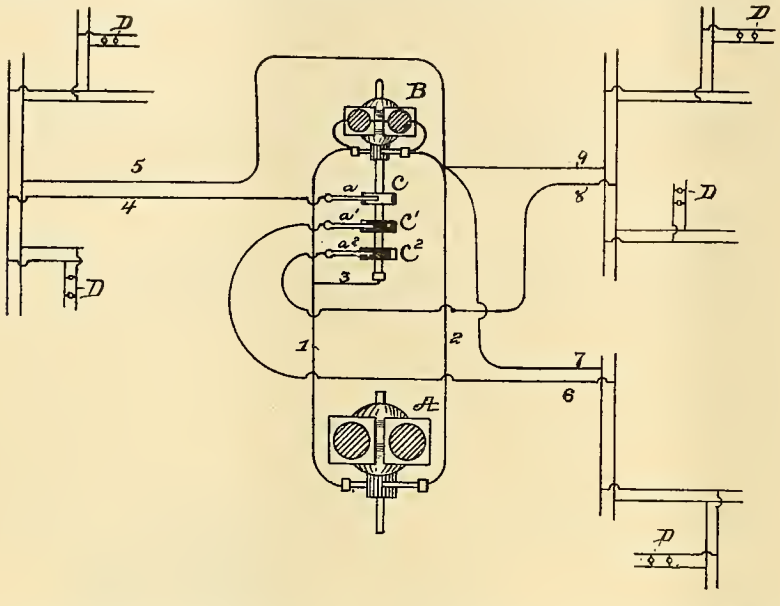
Edison's High Tension System.

Among the electrical patents listed in the usual place in the WESTERN ELECTRICIAN this week is one issued to Thomas A. Edison for a system of electric lighting. The object the inventor has in view in the invention is to produce a system of electric lighting wherein high tension currents can be used upon the main conductors or feeders, and incandescing electric lamps, located in independent multiple arc circuits, and requiring a continuous current of lower tension, can be supplied, enabling the use of smaller conductors, and making it possible to economically supply lamps at greater distances from the source of electrical energy than when a simple multiple arc arrangement is employed.

The invention, so runs the patent specification, is based upon the discovery that the electrical energy consumed by an incandescing electric lamp may be controlled independent of the tension of the current and the resistance of the lamp—provided the tension of the current is greater than the lamp requires when constantly in circuit—by interrupting the flow of current to the lamp, and the light can be made to appear constant to the eye by making such interruptions of the current with sufficient rapidity. Thus an incandescing lamp requiring, when constantly in circuit, a current of definite tension to maintain it at normal incandescence, may be supplied from a circuit having a current of two or

more times that tension, provided the circuit through the lamp is interrupted, so that current will flow for only a fraction of the time through the lamp, that fraction being inversely the number of times the tension used is a multiple of that required when the lamp is constantly in circuit, or approximately that proportion.

In carrying out the invention for a general system, the inventor proposes to run the circuit of high tension to one or more points within the district intended to be supplied, and there divide the current between two or more circuits containing incandescing electric lamps or other translating devices by means of a rapidly acting circuit controller, which will throw the current



first through one lamp circuit and then through another, keeping each lamp circuit complete for a fraction of the time only. This circuit controller is preferably a revolving shaft carrying circuit controlling wheels upon which rest suitable springs or brushes, and this shaft is preferably operated by an electro dynamic motor located in the high tension circuit. Each lamp circuit will be broken at a number of points to reduce the spark. The high tension circuit may be a simple circuit or a compound circuit—such as is used in Edison's compensating system—and in the latter case each part of the compound circuit will be treated the same as a simple circuit. The points at which the high tension current will be divided may be centers of consumption, from which main conductors will run to house circuits in the vicinity, the locality being divided between two or more circuits of main conductors, according to the tension used; or the lamps of each building may be divided between two or more circuits, and a motor working a commutator, and placed in the high tension circuit, be located in the building itself.

Instead of dividing the lamps of a house between two or more circuits, they may be placed in one circuit, and a local circuit controlling motor may be used in the house, which will interrupt the flow of current to the desired extent. The economy of this last arrangement would be dependent upon the fact that the numerous local circuit controlling motors would not work synchronously. All of these arrangements are adapted for use with a compound or compensating high tension circuit as well as with a single high tension circuit, and the different arrangements may be used together in the same system, if desired.

Each circuit controlling motor is preferably provided with a speed governor controlling the lamp circuit or circuits controlled by such motor, and closing such lamp circuit or circuits only after the motor has attained normal speed, and breaking such circuit or circuits when the speed drops below the normal limit. This will prevent the breaking of the lamps, and is especially applicable to local motor circuit controllers in houses, but may also be used to advantage on motors at stations to prevent damage when the lamp switches are closed before the motors attain normal speed.

The accompanying illustration is a view, principally in diagram, of a system with a simple high tension circuit embodying the invention. *A* is a dynamo or magneto electric machine operated by a water wheel, steam engine, or other prime motor, and having a high electromotive force—for instance, 300 volts. From this machine extends the high tension circuit, 1, 2, and included in this circuit is the distant electro dynamic motor, *B*. The shaft of this motor carries three circuit controlling wheels, *C*, C^1, C^2, the periphery of each of which is one-third metal and two-thirds insulation. Upon these wheels rest brushes or springs, *a*, a^1, a^2. The wheels, *C*, C^1, C^2, are so arranged upon the motor shaft, or the brushes, *a*, a^1, a^2, are so arranged to bear upon the wheels that when one brush is on metal the other two brushes are on insulation. The motor shaft is connected by conductors, 3, with one side of the high tension circuit, 1, 2, while between the brushes, *a*, a^1, a^2, and the other side of circuit, 1, 2, extend lamp circuits, 4, 5, 6, 7, and 8, 9, in which are included incandescing electric lamps, *D*. The circuits, 4, 5, 6, 7, and 8, 9, form a locality at a central point in which the motor, *B*, is located. The lamps, *D*, require, when constantly in circuit, an electromotive force of 100 volts to maintain normal incandescence. The energy of circuit, 1, 2, is divided between the three lamp circuits by the circuit controller, each lamp circuit being completed for one-third of the entire time, and the motor has a sufficiently high speed to make the incandescence of the lamps constant to the eye. Other motors may be arranged in circuit, 1, 2, controlling lamp circuits the same as motor, *B*.

The Card Constant Current Motor.

The George F. Card Manufacturing company of Cincinnati, O., since placing its first constant current motor in service a year ago, has been actively engaged in making such improvements and changes as experience dictated, and now is producing the motor shown by the accompanying illustration. There are several novel points of construction, which use of the motor has proved to be meritorious. Among the most prominent features of the motor is the peculiar arrangement of the magnets. There are, as in the well-known double horseshoe type of machines, two magnetic circuits, but the axes of the magnets instead of being in the same line, are at right angles. This disposition of the iron makes the machine compact and gives it great rigidity.

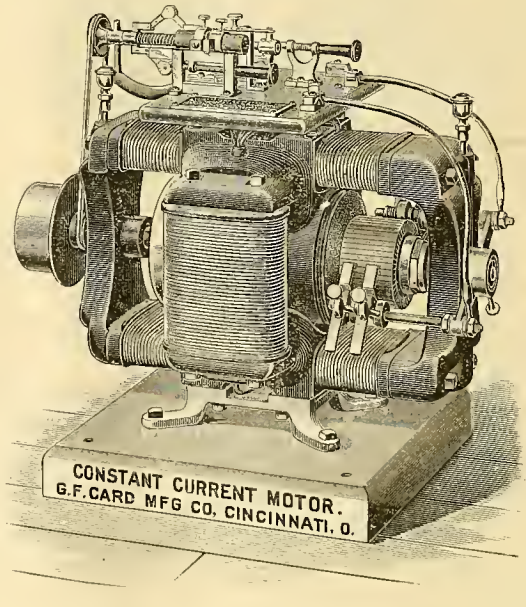
The commutator is of unusually large diameter, the segments made of pure copper and are drop hammered to nearly one-half their original thickness, making an exceedingly hard and tough bar. Mica of the best quality is used for insulating the segments. The same size commutator is used on the one and the one-half horse power motor. This commutator has forty-eight segments. The commutator on the two horse power motor is larger, and has fifty-six segments. As might be inferred, the object of this method of construction is to prolong the life of this troublesome part of a motor and to avoid the necessity of turning off the commutator to make it true. The brushes are double on each side.

The armature is of the Gramme ring type and is built up of charcoal iron rings which are first dished and then well insulated. This construction avoids the necessity of rods or bolts to hold them in place. At each end of the core a cast iron spider for attaching the armature to the shaft is placed, and through the medium of these spiders the armature is bound together.

The shaft, which is large in diameter and made of the best quality of tool steel, runs in interchangeable adjustable bush bearings of phosphor-bronze.

The terminals of the armature coils are brought out at the end opposite the commutator and are connected to the segments by means of large wires extending through the space between the winding and the shaft. This provides an excellent way to secure contact, and also renders it convenient to take the armature apart if necessity should require it.

A perfect running balance is obtained by means of an adjustable brass plate on the shaft, which also serves as a protector to the coil terminals. The balance for each motor is obtained in the shop.



Mr. Card's method of regulation is ingenious, and at the same time very simple. A WESTERN ELECTRICIAN representative saw one of the motors in operation, and Mr. Card demonstrated the capability of the regulator by adjusting it so as to give the motor various speeds ranging from 200 to 2,500 revolutions per minute. The

regulator consists of a differential coil of low resistance in shunt relation to the series magnetizing coil and a centrifugal governor driven from the armature shaft by means of a rubber belt made especially for the purpose. One end of the differential loop terminates at a carbon point held securely in a bracket movable on a line parallel with the governor shaft by means of a screw. The other end also terminates at a carbon point which with its holder, forms part of governor mechanism. When the motor is started, this part of the governor is open and the current flows through the direct series coil, quickly increasing the speed until the two carbons are brought in contact; the current divides, part flowing through the differential coil and part through the direct coil, the ampere-turns in the former being sufficient to neutralize the effect of the latter and demagnetize the field. The tendency is for the armature to stop, but the slightest reduction of speed acts to separate the carbons and bring into full effect the current in the direct coil, which quickly pulls them together. As a matter of fact the shunt coil is never completely open, the governing carbon keeping up a constant vibration. By means of a thumb screw the fixed carbon can be moved forward or backward to increase or diminish the speed. The carbons are of the finest quality and are one inch in diameter. A contact point is provided, and in case the governor belt breaks or flies off, the arms collapse and close the reverse coil, stopping the motor at once.

These motors are built for the arc or incandescent circuit.

Porter Electric Messenger.

The accompanying cuts illustrate the Porter electric messenger, which is designed as a particularly convenient and reliable annunciator for

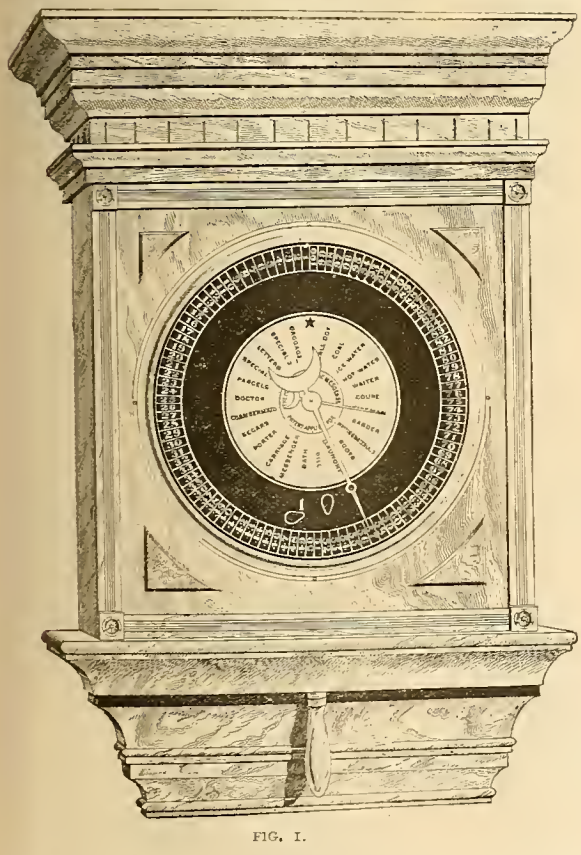


FIG. 1.

hotels and apartment houses. The especial feature of the system is that a guest, by means of the apparatus, may not only signal to the office, but may, at the same time, indicate what he wishes. The office annunciator, Fig. 1, is provided with a dial 20 inches in diameter, upon which appear the numbers corresponding to the rooms. The long hand or pointer, as shown, designates the room from which the message is sent. The short hand shows what is wanted.

Each room is provided with a circular call box, Fig. 2, on the dial of which is printed the names of twenty or more different articles, such as are usually required by the guests. The hand, as shown in cut, may be moved in either direction by means of a knob in center of dial.

To operate the instrument, the occupant of the room first opens the hasp of the room box, turns the little hand to the required want, then closes the hasp, leaving it in this position; this sets in motion the hand on the dial in the office, which swings around until it reaches the number corresponding to the room from which the call has been sent, where it stops. At the instant the long hand stops at the room number the short hand begins moving, stopping as soon as the want indicated by the little hand in the room box has been reached. This action carries the hand in the room back to the star, which is a signal to the guest that the message has been received.

This apparatus can be placed in any hotel using other annunciators, and made to operate on the same wires without making any change.

The annunciator will convey correctly every message sent from the rooms, though 100 guests may call at exactly the same instant. The Porter electric messenger is now being put on the western market by G. A. Harmount, Western agent electrical department New Haven Clock company, Chicago.

Electricians at Edison's Laboratory.

Over 250 persons assembled at the Edison laboratory, Orange, N. J., Wednesday evening, October 24th, to attend the meeting of the New York Electrical society, which was held there on the invitation of Thomas A. Edison. One of the electricians of the laboratory, Arthur E. Kennelly, delivered an admirable lecture on "Electrical measurement," which was listened to with the closest attention for nearly two hours. After the lecture a short explanation of the improved phonograph was given, and several of those instruments were shown in operation, reproducing songs, speeches and various other sounds. Among the cylinders used was one which convulsed the audience, as it reproduced the squalling of Mr. Edison's baby. The audience then

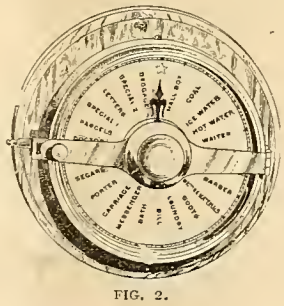


FIG. 2.

adjourned to the library, a magnificent apartment running through three stories of the immense building, and containing thousands of the rarest volumes on electrical subjects. The laboratory proper was also thrown open to the visitors. This contains the finest private collection of electrical apparatus to be found in the country, if not in the world. Mr. Edison was present at the meeting, and received a hearty vote of thanks from the audience for his courteous invitation to the society. The New York and Brooklyn visitors were brought back by a special train over the Erie railway.

The Central Electric company of Chicago reports large sales of okonite wire and Candee aerial wire. The insulation has proved so effective and so durable that companies find it pays to purchase it. Several orders for 35,000 and 50,000 feet have been recently received.

Practical Telephony.

By Thomas D. Lockwood.

PART XIII.

I have about exhausted my budget, so far as the regular appliances of everyday telephony are concerned. I now propose to say something about the practical working of that part of the subject which is popularly, albeit somewhat hazily, called "long distance telephony." It is not easy to define or point out scientifically the exact spot on a telephone line where the distance ceases to be short, and becomes long; and the term, therefore, hardly seems well chosen. It seems, however, to refer to lines over which the Blake transmitter, when used as a regular instrument, will not convey practically successful and easily understood conversation. It is not necessary to suppose that the Blake transmitter is often incapable of doing good work over a distance of 100 miles or more. I have often participated in conversation where it has been used as a transmitter, and where, though the distance was greater than 100 miles, the talk was reproduced as clear as a bell, and with Gladstonian perfection of articulation; but I could never go to that line, or to others like it, and be quite confident that I was going to have a perfectly understandable conversation.

We must not, however, attribute all the uncertainty or doubt that hangs round talking of fifty miles or more in distance to the transmitter. The average telephone exchange line of, say, five years ago, was anything but a *chef d'œuvre* of electrical construction. What with the imperfect conductivity of the line wire, the very fair conductivity of the insulation, the high resistance of ground terminals, the loose switch board connections, and the absolute certainty of the inclusion of several electro-magnets in the line, it was a ticklish matter to talk without loss of temper between two points in the same city, especially when the city happened to be one of the physical conformation of New York, and to be described with substantial accuracy by the definition of a geometrical line, as possessing length without breadth. When, however, to the exchange line at both ends we must add a long connecting link of like character, the work of telephonically talking becomes almost superhuman.

To transmit conversation regularly and easily, and to reproduce it over distances of over fifty miles with commercial success, was a problem; and it was gradually recognized that, to accomplish such transmission over such distances, everything—lines, telephones and switching appliances—would have to be built and made just as well as they could be; that loose connections in lines and switch boards could no longer be tolerated; that both the resistance and the electrostatic capacity must be kept down to their lowest point; that the lines must be kept practically free from both external and mutual disturbance; that electro-magnets must, as far as possible, be kept out of the circuits, and that such as were included therein must be so arranged as to develop as little counter-current as possible. Lines have lately been built with the requisite care and attention to detail, and the results have amply justified the labor and care expended, so that it is no longer doubtful that the telephone can be satisfactorily operated over distances of five, six, and nine hundred or a thousand miles, the only question now being, will it pay? The lines are, however, chiefly a matter of construction, and with that subject we have in the present series of papers little to do. We have to do with the instruments. Doubtless the standard Blake transmitter would be able to talk over 250 miles with comparative ease, if the line and circuit were as good as they could be made, and if they were free from disturbance. But lines even now are not always up to a high standard, and it often happens that between two points at least a part of the through line has to be made up of poorly built sections, or of sections in poor repair. It is, in any case, advisable to have instruments which are able to work powerfully over the worst line which can be provided for them.

No better receiving telephone has ever been produced than the regular Bell magneto instrument. Under the law of the "survival of the fittest," therefore, this instrument has never been

superseded, and seems to be just as well adapted for long line as for short line work. In fact, if anything, it is too sensitive, in that it scoops up all the stray currents which may happen to be floating round loose, anywhere near its circuit. For long line work there is then no other instrument used as a receiver than the regular hand telephone.

But the transmitter has been changed. Very soon after Prof. Hughes elucidated his discovery of the microphone in England, it occurred to an English clergyman, who was an amateur electrician, that good results might be telephonically attained by the use as a variable resistance of a mass of granulated or powdered carbon, loosely confined in a chamber between, or in contact with, the two electrodes of a battery circuit, in which was also included a receiving telephone. He tried it, found that the experiment was successful; and after making a few of the instruments, patented the invention in England, and

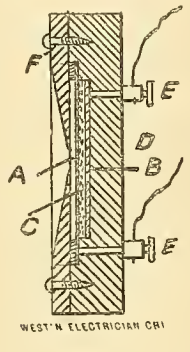


FIG. 17.

later in the United States. One of the important features of this instrument is that the granular or powdered mass must not be tightly inclosed or compressed in the inclosing cell or chamber.

The patents of Mr. Hunnings do not refer exclusively to the use of carbon, but comprehend any current varying material which can be used, provided it is used in a granular or powdered form, and in a loose or free state. The instrument, as Mr. Hunnings made it, is very simple, and in many circumstances very efficient.

Fig. 17 shows this instrument as it was when patented, consisting of a wooden case, having a shouldered depression cut into one side. A brass plate, *B*, was fixed in the bottom of this depression, and was united by wire with one of the binding screws, *E*. The depression was then nearly filled with crushed carbon, *C*; the patent says that oven-made engine coke is preferred, and the front of the cavity was closed with a piece of platinum foil, *A*, which served as a vibratory diaphragm, this latter having a wire uniting it electrically with the other binding screw, *E*. The addition of a perforated wooden cap piece, *F*, the perforation being widely counter-sunk on one side to serve as a flaring mouthpiece, completed the instrument. The flat vocalizing chamber, which in all telephones seems necessary to perfect articulation, is provided by interposing a packing ring between the under surface of the cap piece and the edge of the diaphragm, the shouldered recess being made sufficiently deep for that purpose. When good clean coke was employed in this instrument, and when the cavity was filled just right, neither too much nor too little, the work it would do was magnificent. No induction coil was used or contemplated, the instrument being placed directly in circuit with the receiving telephone, and as much battery as might be necessary.

No exact rule appeared to exist for proportioning the battery to the circuit, and when the gentleman who brought the first specimens of the Hunnings transmitter to the United States was asked about the amount of battery to be used, he said that the Rev. Henry had calculated that the amount of battery necessary would depend upon the length of the circuit, and that one cell of a blue vitriol battery might be employed for each mile of ordinary line. It was not in this system necessary to provide the receiving telephones with permanent magnets, since the battery effected a certain amount of magnetization in the iron core; and if a permanent magnet were used, the best results were attained by so connecting the receiver with the battery that the current of the latter tended to intensify, and not to diminish, the initial magnetism. Some trials took place between Boston and Providence, a distance of forty-four miles, and, in accordance with the elastic rule of Mr. Hunnings, forty-four cells of gravity battery were used. This was gradually reduced to ten cells without perceptibly diminishing the volume of the reproduced tones, and later the battery was cut down to one cell, but the transmission was still good; so good, in fact, that some one suggested that probably this transmitter could work without any battery, and the last cell was, in accordance with this suggestion, taken off, but the transmission was, of course, then completely killed. The American Bell Telephone company bought the United States patents, and has, from time to time, prosecuted a series of experiments tending to the improvement of the instrument, which, so far, have eventuated in the present "long distance transmitter," so-called. It was wonderful to note how far the Hunnings instrument, in its unimproved condition, would work in direct circuit with battery, line and receiver, and work well; but it was rather uncertain, and had its ups and downs. Sometimes it would be working like a charm, when all at once the volume of the sound would go down to almost nothing. The line and receiver were, of course, subjected to change with every fluctuation of the battery, and the result was a return to the induction coil. The main reason for the use of the coil was, as has been before stated in these articles, to permit the changes in resistance produced by the transmitter to affect the current flowing in a short circuit of low resistance, it being clear that these changes would be a much more efficient factor in such a circuit, and produce a much greater ratio of change than they possibly could in a circuit of high resistance, while by means of the induction coil the changes effected in the short circuit could be propagated to the line circuit with equal force.

The *modus operandi* of a granular carbon transmitter is as follows: The mass of loose, finely divided carbon, or like conducting matter, is by means of the front and back plates of the inclosing chamber, included in the circuit of the battery, and the battery current, consequently, flows through it, and from particle to particle. The transmitter, when in operation, was held in an inclined position, with the mouthpiece leaning back from the face of the user at an angle of

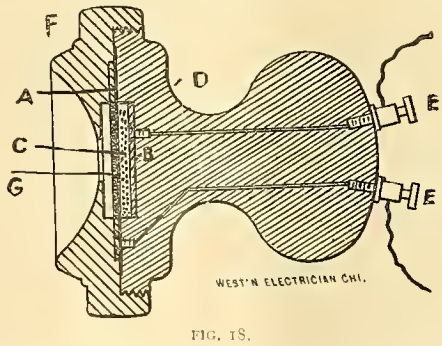


FIG. 18.

about forty-five degrees. When in this position, if the transmitter be spoken to, the platinum diaphragm was vibrated, and the intimacy of contact pressure between many of the neighboring particles was also varied. The resistance necessarily varied with the intimacy of contact, and the result was, of course, that the strength of current varied, with the resistance; and as might have been expected, there being so many points of contact, the total variation of resistance and current was much more considerable than in transmitters possessing but one variable point.

Fig. 18 shows the first American form of Hunnings, and is seen to be a portable and convenient style. The handle, *D*, was of hard rubber, while the back plate, *B*, and foil diaphragm, *A*, were respectively of brass and platinum, as in the original. Small holes ran through the handle for the passage of connecting wires, which united the diaphragm and back plate with screw terminals, *E*, *E*. The carbon-containing cavity was diametrically smaller, the crushed coke, *C*, was caused, as before, to nearly fill the cavity, the side wall of which was formed by the hard rubber of the handle. A piece of brass, *G*, with a great many holes drilled through it, was screwed down over the platinum foil to keep it in place, while the sound waves reached the diaphragm through the holes in the plate. A rubber cap piece provided the usual mouthpiece.

Instruments made according to this plan worked very well at first, but unaccountably failed after a few weeks' use. It was found that the brass back plate became covered with a non-conducting oxidation; that the crushed carbon would burn when the current was passed through it; and worst of all, that in some unaccountable way moisture collected in the cavity, and tended to pack the carbon into a comparatively solid mass, even when dry packing supervened to some extent, and instruments on this principle were temporarily discarded.

(To be continued.)

Bell Hangers' Hand-Book.[1]

By F. B. Badt.

PART IV.

ELECTRO MAGNETS.

CHAPTER XXXIV.

Electro-Magnets.

In Fig. 23 is shown a voltaic cell with the circuit spirally coiling around a soft iron bar. This bar, when the current

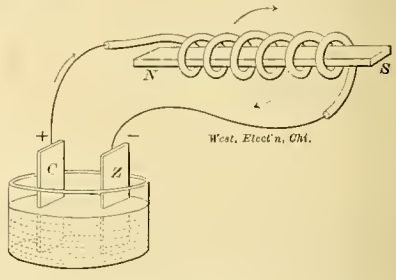


FIG. 23.—MAGNETIZATION OF AN IRON BAR.

is passing, becomes an electro-magnet. The separate turns of wire must not touch each other or the iron bar, as this would cause a short circuit through which the current would pass. The wire must be insulated. The iron bar is a mag-

FIG. 24.—RIGHT HAND WOUND MAGNET.

net only as long as the current flows. Its magnetism is under control. When circuit is made the bar becomes a magnet, when circuit is broken it loses its magnetic power.

Every electro-magnet has a north and south pole like a

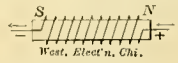


FIG. 25.—LEFT HAND WOUND MAGNET.

steel magnet. The end which the *positive* current enters, a *right hand* wound electro-magnet, Fig. 24, becomes a *south pole*, and the end which the *positive* current enters, a *left hand* wound electro-magnet, Fig. 25, becomes a *north pole*.

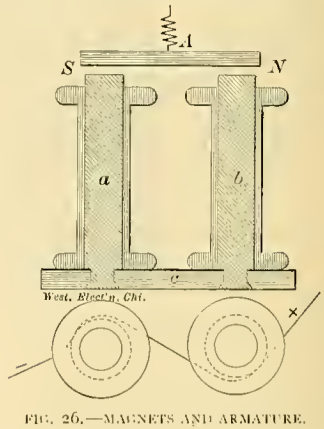


FIG. 26.—MAGNETS AND ARMATURE.

The most useful form of electro-magnet is that in which the iron core is shaped like the letter U—often called a horseshoe magnet—so that both poles may be applied to one iron armature.

In Fig. 26, *A* is the armature held up by a spiral spring.

[1] Bell Hangers' Hand-Book, by F. B. Badt, author of Dynamo Tenders' Hand-Book; in course of preparation; about 100 pages, 80 illustrations; flexible cloth binding; type page 6 inches by 3 inches; price $1. All rights reserved.

a and *b* are the iron cores which carry the bobbins of wire and *c* is an iron connecting piece.

Fig. 27 represents an electro-magnet used in finer instruments.

FIG. 27.—INSTRUMENT MAGNETS.

Fig. 28 represents a common horseshoe electro-magnet. The spiral spring *A* in Fig. 26 is called the tension or

FIG. 28.—COMMON MAGNETS

adjusting spring. It must be so adjusted that it is just strong enough to pull the armature from the pole pieces of the magnet when the circuit is broken.

To prevent the armature from "sticking" to the pole pieces, the latter are generally covered with paper or with a thin layer of brass or copper. Soft iron after having been magnetized retains a small amount of magnetism which is called residue magnetism.

The lifting power of a horseshoe magnet is considerably greater than that of a bar magnet of the same weight.

The magnetizing power of the coil of wire surrounding the iron core depends upon the number of turns of wire and the strength of the current passing through it or as it is generally expressed, upon the number of ampere-turns. For instance, 10 turns of wire with one ampere of current flowing through it would be 10 ampere-turns and would have the same effect as 5 turns of wire with 2 amperes of current, which would also be 10 ampere-turns.

INDUCTION COILS.

CHAPTER XXXV.

Induction Coils.

A magnet will induce magnetism in a piece of iron brought near it In a similar way a closed wire circuit through which a current is flowing will induce electric currents in another closed wire circuit brought near it. In Fig. 29 *a b* is the wire conductor through which the cur-

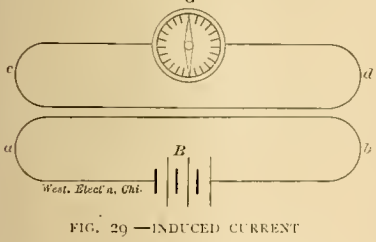


FIG. 29.—INDUCED CURRENT

rent of battery *B* flows; in the closed circuit *c d* is the galvanometer, *G*. As soon as the battery curcuit is closed a current of very short duration is set up in the circuit *c d*. This current has the oppo-ite direction from the battery current As soon as the battery circuit is opened another current of short duration is generated in circuit *c d*, but this current flows in the same direction as the battery current. The galvanometer needle will deflect in these two cases in opposite directions.

The induction coil is based on this principle. It consists of a cylindrical bobbin having a central iron core surrounded by a short inner or primary coil of stont wire, and by an outer secondary coil consisting of many thousand turns of fine wire, very carefully insulated between its different parts. The primary circuit, in which are also in-

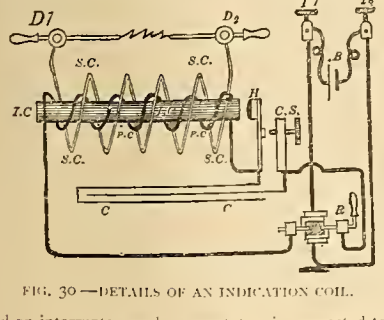


FIG. 30.—DETAILS OF AN INDICATION COIL.

cluded an interrupter, and commutator, is connected to the poles of a galvanic battery.

The object of the interrupter is to make and break the primary circuit in rapid succession. The currents at "make" are suppressed by the condenser, while the currents at "break" manifest themselves in a brilliant torrent of sparks between the ends of the secondary wires when brought near enough together. The condenser is made of alternate layers of tin foil and paraffined paper, into which the current flows whenever circuit is broken. The condenser prevents the spark of the extra current—set up in the primary circuit by self-induction—from leaping across the interrupter and weakens the inductive action in the secondary circuit at "make."

The induced currents are of very high e. m. f. and will leap across considerable space. This coil, for instance, is

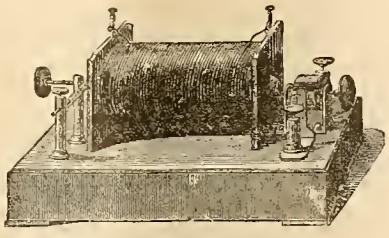


FIG. 31.—INDICATION COIL WITH AUTOMATIC CIRCUIT BREAKER.

used to ignite blasting cartridges and for electric gas lighting, etc.

Fig. 30 shows the details of an induction coil. T_1 T_2 are the terminals to which the wire from battery *B* are attached. *R* is the reverser or commutator for reversing or cutting off the current *C S* represents the platinum pointed

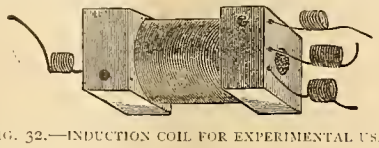


FIG. 32.—INDUCTION COIL FOR EXPERIMENTAL USE.

contact screw in the primary circuit. *H* is a hammer of soft iron, the movement of which completes and breaks the circuit at C S. *C* is a condenser for arresting the momentary direct induced current in *P C*, the primary coil of thick wire, through which the battery current passes. *S C* represents the secondary coil of well insulated fine wire in

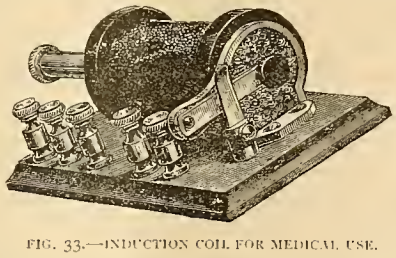


FIG. 33.—INDUCTION COIL FOR MEDICAL USE.

which sparking currents are induced. D_1 and D_2 are spark dischargers fitted to the ends of the secondary coil *I C* is an iron core made up of a bundle of very soft iron wires.

Fig. 31 shows a commercial form of induction coil with an automatic circuit breaker; Fig. 32 another form designed for experimental use, and Fig. 33 still another form designed for medical use.

ELECTRIC BELLS.

CHAPTER XXXVI.

Electric Bells.

The common form of an electric vibrating or trembling bell consists of an electro-magnet E, Fig. 34, which moves a hammer H to and fro by alternately attracting and releasing it, so that it strikes against a bell. By pushing the button P the circuit is closed and the electro-magnet attracts the armature which carries the hammer. The armature is one part of the circuit, the current entering above and leaving it at C. At this point the contact is loosely made by the spring pressing against the adjusting screw C The contact points of both spring and screw are covered with plat-

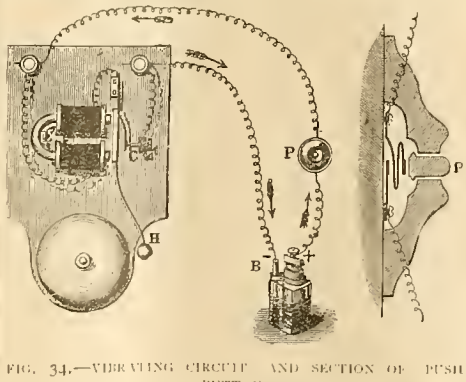


FIG. 34.—VIBRATING CIRCUIT AND SECTION OF PUSH BUTTON.

inum to withstand the action of the electric spark at C. As soon as the lever is attracted forward, the circuit is broken at C by the spring moving away from contact with the screw, hence the current stops, and the electro-magnet ceases to attract the armature. The lever and hammer therefore fall back, again establishing contact at C, whereupon the hammer is once more attracted forward, and so on. The push P is shown in section on the right of Fig. 34. It usually consists of a cylindrical knob of ivory or porcelain capable of moving loosely through a hole in a circular support of porcelain or wood, and which, when pressed, forces a spring against a metal pin, and thus makes electrical contact between the two parts of the interrupted circuit.

Electric bells are generally made in two forms. The skeleton bell is used for the larger and the box bell for the smaller sizes of gongs

When an especially loud and continuous call is required,

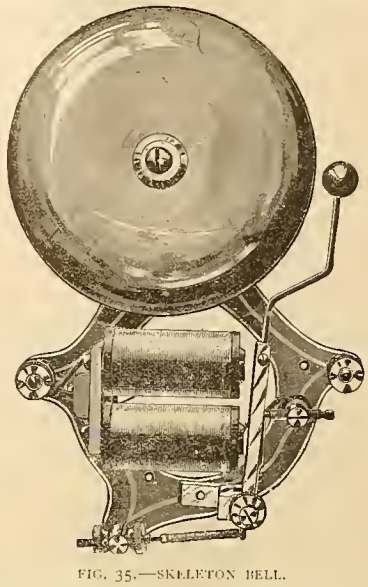


FIG. 35.—SKELETON BELL.

as in large halls or for fire alarm purposes, the electro-mechanical bell is generally used.

Fig 35 shows a well-known form of skeleton bell.

Fig. 36 illustrates a box bell—a name given it from the fact that the cover of the working parts is a box,

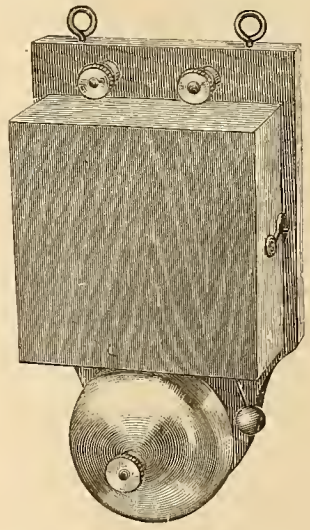


FIG. 36.—BOX BELL.

frequently made of wood and also frequently made of metal. This particular form of bell is designed to be hung upon from supports, but the bells are made to be placed in the reverse position.

(To be continued.)

Reminiscences of Ampere.

The following allusion to Ampere is taken from an article in the London *Electrical Review*:

Great, however, as were Ampere's services to science, they would doubtless have been far greater if he could have kept himself from metaphysics. We know that in middle life Liebig bitterly regretted the time which he had devoted to such studies in his youth. Ampere on the contrary, became more metaphysical as he grew older. He declined to answer a letter on physical and chemical topics which he had received from Davy, having, as he said, "no longer the courage to fix his ideas upon such troublesome things" He actually kept up a correspondence with Maine de Biron from 1805 to 1815, and he regretted that many of his friends did not care for metaphysics.

He was a believer in so-called animal magnetism and admitted that in certain conditions of nervous excitement a man might see without eyes, and read a letter with his elbow. His mind was active only when standing. If seated at a table, pen in hand, his ideas vanished.

Ampere was married in 1779, but had the misfortune to lose his wife as early as 1805, a calamity from which he never recovered. He passed entire days on the banks of the stream where he had first met her, and spent the time in making little mounds of sand. His death took place on June 10, 1836, at the college of Marseilles.

The statue about to be inaugurated is said to recall very vaguely the features of Ampere. When questioned on this subject, the sculptor declared that this deviation from truth was intentional. The object was to ornament a beautiful square, and he, therefore, represented a handsome young man, an Apollo, which Ampere never was.

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CONTENTS OF THE NUMBER.

	PAGE.
Waterhouse Arc Lamp, Illustrated	229
Combination Floor Key and Button, Illustrated	229
Edison's High Tension System, Illustrated	229, 230
The Card Constant Current Motor, Illustrated	230, 231
Porter Electric Messenger, Illustrated	231
Electricians at Edison's Laboratory	231
Practical Telephony, by Thos. D. Lockwood, Illustrated, Part XIII	231, 233
Bell Hanger's Hand Book; by F. B. Badt, Illustrated, Part IV,	
Electro-Magnets	232, 233
Induction Coils	233
Electric Bells	233
Reminiscences of Ampere	233
Editorial	234
The Universality of Vibrations, by C. C. Haskins, and Discussion by Chicago Electric Club	235, 236, 237

DEPARTMENTS.

Correspondence	237, 238
The Electric Light	238
The Electric Motor	238, 239
The Telegraph	239
The Telephone	239
Electrical Patents	240

THE Keely motor is a mysterious invention. The experts who examined it in accordance with the court order, reported that they utterly failed to comprehend Mr. Keely's description of the motor.

IT shows that the telephone has become a well established institution when an Oregon paper has been named the *Telephone.* A few years ago the journal would have been christened the *Telegraph.*

THE Chicago city council is usually engaged in a warm discussion. Just at present the "L" road ordinances are demanding the attention of the aldermen. All electricians are interested in the roads as the projectors are considering the advisability of employing electric motors.

AN explosion occurred in one of the Edison manholes in Boston, recently, and created considerable excitement if the reports of the Boston papers are to be believed. One of the journals referred to the "explosion of electricity." The explosion was due to the collection of gas in the manhole.

BY REQUEST, Mr. Haskins read before the Chicago Electric Club Monday evening last the paper on the "Universality of vibrations," presented on other pages. This paper was originally prepared for a former electrical society and its value secured for it a place in the *Journal of the Franklin Institute.* The illustrations of vibratory law as found throughout all nature are comprehensive and interesting. The paper is particularly apropos, as now with the perfected phonograph, as Mr. Leonard suggested in the discussion, opportunity is afforded to study vibratory law as exemplified in sounds in a manner that was not possible when the paper was written. After sounds have been recorded upon the phonograph, those of a low rate of vibration can be made audible by revolving the cylinder at a high rate of speed, and vice versa, those of high rate of vibration can be brought within the range of the human ear by revolving the cylinder at a low rate of speed. The whole subject was well presented, and received the attention it deserved.

THE Lewiston, Me., *Journal* recently propounded the following questions: 1. Of what nature will be the next economic invention? 2. What great economic invention is most needed and called for by the world? 3. Does anything remain to be invented by man, which shall be as revolutionary in its effects as the application of steam power? Answers to the queries were solicited. Gen. A. W. Greely made these replies: 1. The storage, without appreciable loss, of electricity produced by natural forces, such as waterfalls, tides, etc. 2. A cotton picker. 3. No.

IN this number, Thomas D. Lockwood resumes his interesting series of articles on practical telephony. Mr. Lockwood was unable during August and September to continue this series, which has proved so entertaining and instructive. In the present article the subject of long distance telephones is taken up. Considerable space is devoted to a description of the Hunnings transmitter and of the improvements which have made it serviceable. The difficulties and the possibilities of long distance telephones are pointed out by Mr. Lockwood. The paper is full of interest and it is timely, for the subject is one which is attracting considerable attention at the present time. The next year is likely to see considerable progress in long distance telephones.

IN discussions of the comparative values of the alternating and direct current systems for central station lighting, the objection has been raised against the latter that its area of distribution was limited by the cost of conductors. This objection seems to be met in part, at least, by a new system designed by Mr. Edison, and described in another place, this week. In the new system high tension currents are used upon the main conductors or feeders and can be economically carried to greater distances than when a simple multiple arc arrangement is employed. The idea is to run the circuit of high tension to one or more points in the district to be supplied, and there divide the current between two or more circuits containing lamps, by means of a rapidly acting circuit controller, which will throw the current first through one lamp circuit and then through another, keeping each lamp circuit complete for a fraction of the time only. The principle at the basis of this invention is that the electrical energy consumed by an incandescing electric lamp may be controlled independent of the tension of the current and the resistance of the lamp, provided the tension of the current is greater than the lamp requires when constantly in circuit, by interrupting the flow of the current, and the light can be made to appear constant to the eye by making such interruptions of the current with sufficient rapidity.

IN our New York correspondence the fact is stated that the complications which have existed for some time regarding the right of way for the Bentley-Knight company have been removed, and that now the work of installation can go on unhindered.

Our correspondent takes the view that the success or failure of this road will have a great bearing upon electric railway progress. Upon the road there will be a combination of curves and grades, the streets are dirty and obstructed, and in fact, about all the obstacles there can be imagined, will be present.

There are few places where an electric street railway would meet more obstacles, and consequently success when attained, will be the greater. We will be among the first of "well-wishers of the general electrical cause" to express a devout desire that the system will succeed in overcoming the manifold obstacles to its perfect working.

The large cities of the country, such as New York, Boston, Philadelphia and Chicago, have not yet generally accepted the electric motor for street railways. Lines are in operation in some of the cities named, and they are being closely watched. Naturally enough, the large cities with their crowded streets and unceasing traffic present greater obstacles to an electrical system than smaller cities and towns where restrictions are not so severe, consequently the electric motor makes slower headway in large cities than in small, but we confidently look forward to the time when the street car lines of all the large cities will be operated by electricity.

Meantime, the progress of the electric motor in smaller towns, and especially those of the energetic west, is as encouraging as the most ardent could wish for, and the operation of the systems as satisfactory as could be desired.

JUDGE BLODGETT of Chicago, of the federal court, handed down a decision Monday last, granting the Bell telephone company an injunction, *pendente lite*, for infringement against the Cushman company. This is the case referred to in these columns last week, and Judge Blodgett thus disposed of the point to which attention was briefly called:

"Defendants are engaged in furnishing telephone service and operating exchanges in several cities in Indiana and insist that an injunction should not be granted on this motion, because a few years since the complainant's grantees or licensees established telephone accommodations in some, if not all, of these cities, but withdrew therefrom after the passage by the legislature of Indiana of an act limiting the rates of charges for telephones and for telegraphic services.

"I do not think the fact that the complainants, licensees, or grantees have withdrawn their telephonic accommodations from these cities furnishes any excuse or defense for the infringement of these patents by these defendants. The law gives the owner of a patent the exclusive right to the use of the device covered by his patent, and the rule that because the patentee or owner of a patent cannot agree with those who wish to use his device as to the price to be paid for such use, authorizes another to pirate upon the patent with impunity, would be destructive of patent property."

The decision then takes up the question of the validity of the Indiana statute:

"Counsel for the defendants insist that the main question involved in this case is the validity of the Indiana statute regulating the charges of telephone service, but I do not consider that question involved in this motion. It was stated on the argument of this motion, and I doubt not truly, that this question is in the way to be presented at an early day to the Supreme court of the United States, which is the proper tribunal to pass upon it. But it would be strange indeed if, where A is the undisputed or adjudged owner of a patent which B wishes to use, but B is not willing to pay the amount demanded by A for such use, therefore C can infringe the patent and supply B with infringing machines and not be restrained from so doing, when the validity of the patent and infringement are clear."

Counsel for the Cushman company had argued that Judge Blodgett had decided in a former case, Hoe *vs.* Knapp, that a patentee who did not put his patent into use was not entitled to an injunction, and that decision was invoked by defendant's counsel on the argument of this application for this injunction. "I think, however, that the case there made was another and widely different one from this," runs the decision. "There the patentee had never made a machine nor put his patent into use; he had simply locked it up, so to speak, and kept the public from the benefit of it. Here the patentee has put his patent into extensive use and is receiving a large income for such use at rates agreed upon between the owners of the patent and the users; so that this complainant does not stand as the complainant did in the case cited."

The decision means another complete victory for the Bell company, though it was to be expected after the former decision by the same judge some months ago, giving to Alexander Graham Bell priority of invention of the speaking telephone over Dr. S. D. Cushman.

The Universality of Vibrations [1]

By C. C. Haskins.

Vibrations, in the most limited sense of the term, are defined as minute reciprocal motions of the particles of an elastic body when they are thrown out of equilibrium. Oscillations embrace a class of movements which may be termed vibrations of greater dimensions—the two differing only in degree. These may traverse vertical arcs or horizontal curves, parts or the whole of circles or ellipses. Amplified still further, we find movements embracing extended cycles of time, yet ever returning to a former condition or position. These are all, generically speaking, vibrations, differing only in the one element of time. We may go farther and include as vibrations all that class of changes or motions which have the one common similarity of starting at a given point, origin or condition, and having accomplished a change of place, form or position—a cycle of movement or transition—returned to their pristine status; again and again repeating this round of differing phases.

These periodic rounds, whether comprising two or more changes, whether molar or molecular, I have classed as vibrations, and within this scope I include the movements of elastic bodies, springs, chords, gases, etc., the segmental action of suspended bodies like pendulums, the gyratory movements of storms, the progression of planets in their orbits, and those chemical changes which are ever active in nature, producing combinations in the mineral, animal and vegetable world, by which the various conditions of growth and decay so constantly and regularly succeed each other.

These mutations—now noiseless, hardly perceptible in their slow progress, at other times bold, rapid even to instantaneity—eventuate in the same accomplishment, the restoration of the elements to their simplest form and their recombination in the chemical world, in the world of motion—to repeat for all time this round of change, this following in the beaten path of nature's ages—periods of time of which the mind of man can take no cognizance.

Take an example: An internal chemical commotion occurs beneath the crust of the earth's surface. In harmony among the existing elements as combined results in greatly increasing the volume of these, and the stored up energy heretofore confined is set free This energy is expended in the line of least resistance, and the result is an upheaval of the earth's surface. A mountain is born. One limit of the vibration is reached. Rains descend upon the upheaved surface, penetrate the crevices of the rocks, dissolving and carrying portions of these in solution to lower levels. Winter, with its irresistible frosts, widens the seams in the most obdurate rock-formation, crumbles, and slowly—but surely—reduces them to a comminuted condition where they may again become sedimentary rock, once more to be subject to the will of the great plowman Nature, whose implement is the earthquake, whose furrows are the mountain ranges.

Within the earth, deep hidden from human ken, where the rock formation is of a nature to permit, huge caves are in progress of formation. Metallic bases, combined with acids, in the form of flakes or nodules, absorb the infiltrating moisture from above, and the acid, having a greater affinity for the alkaline rock than for the metal, leaves the latter and uniting with the former produces a new compound, which, being soluble in water, is carried away in the outgoing current The metal, too, forming a new combination with the oxygen of the water, is similarly disposed of and a cavity is formed in the bowels of the mountain. Here is the nucleus for a cave. In this way Mammoth Cave was formed; and Nature, tireless designer that she is, is still at work making additions and modern improvements in these, her magnificent underground palaces.

The transitions of water are familiar to you all. As rain it descends from the clouds, it penetrates the earth, evaporates, and is again precipitated upon the ground. It may assume the form of ice, or snow, or clouds, or steam—yet it is still water—the two combined elements of its existence are ever present. We may separate these by force and the same force will re-unite them. We may rarify the fluid by heat, or condense it by the withdrawal of that force, but it remains water still. We have added nothing which did not exist before. We have taken away nothing. Thus we may ring all the vibratory changes on any subject in nature. We destroy nothing, we add nothing, and the conditions which wrought former changes and produced previous results will invariably repeat the phenomena in obedience to the unwavering fiat of vibratory law.

Our sulphate of copper batteries give us a fine exemplification of such changes from an electrical and chemical standpoint. Sulphate of copper, a combination of sulphuric acid and metal copper, is soluble in water. This forms one of the elements of our battery. Metallic zinc is used for the other. These are placed in water, and the connections being made, which render the circuit complete, the stored up energy of the elements is released, the salt of copper is dissolved, and its component parts, sulphuric acid and metallic copper, are separated The copper, restored to its metallic form, is deposited at the bottom of the jar. The sulphuric acid attacks and combines with the metallic zinc, producing sulphate of zinc, which is held in solution by the water. Now when the action is continued until the elements are consumed, by evaporating the water and weighing the residuum, we will find just as much copper, and zinc, and acid as originally existed, but the combinations have been altered, and by still further manipulation we may separate the acid and the zinc, reducing the former to a liquid form, and the latter to its metallic state, and recombine the acid and the copper so as to complete the cycle of vibration and erect a second battery, similar to the former, from the same elements.

Water in motion presents a fine illustration of one form of vibration. If we carefully observe a floating body, a chip, or a bird, on the dead swell of the sea, we shall find that the water motion does not carry the object away from its position, but merely compels it to rise and fall perpendicularly. A rope suspended from one extremity, when shaken, will give us the same wavy motion. The vibratory undulations will run from the one extremity to the other, until overcome by gravity, they cease to be noticeable.

The vibrations of a large body of water, like the sea, are complex and of nearly every degree of amplitude. Not a breath of air passes over it; not a ray of light or heat penetrates it; not a sound is produced at the surface, within or below it, but creates a vibratory movement in the mass. The waves, the tides, the currents, the evaporation, the very color of the sea are as strictly amenable to vibratory law as are the strings of the violin or the pipes of a church organ.

Vegetable life furnishes another familiar illustration of vibratory law—this cycle of existence.

At first the seed, selecting and absorbing the proper nourishment from the surrounding soil, chemically changing the force thus released to its own use, it increases its dimensions, sending certain portions of its organism in search of farther food below the surface, and directing other members upward until its growth is finished, its mission ended, it first ceases to provide for the continuance of its species, then dies and decays and is returned to the soil and the air from whence it came. It has resolved into its primal elements and completed its vibratory cycle. Yet there are minor vibrations in constant motion during its entire life period, each complete in its own sphere of action; each to an extent a necessity, an element in the grand result.

Within the minute vessels, those veins and arteries that lead from the tiniest rootlet to the uttermost extreme of the highest leaf on the tree, what quantities of life-blood have been carried up from the ground for its sustenance and refreshment. Thousands of hogsheads of water have been transported to the tops of the forest monarch during its years of growth, carrying with them the elements required for the food and growth of the wood, the bark, the leaves and the fruit, in addition to the forced contribution which the atmosphere has been compelled to contribute, and these elements have been appropriated, separated, assigned and assimilated, all in obedience to and by the aid of vibratory law.

The summer's growth, the winter's rest, the ripening and falling of the leaves and fruit, regular as are the seasons, are but so many annual vibrations in its period of existence.

Its various parts, too, are in constant motion, and whether we note the swaying trunk and bending limbs contending with the wintry gale, or the pendulum leaves gently waving in the summer breeze—vibrations in some degree or form are still the same ever present accompaniment of its daily life.

As in the tree, so in the tiny blade of grass. Could we but invent some method of multiplying our hearing capacity in the same degree as the microscope has enlarged the field of human vision, every blade of grass, every clover stalk and daisy stem would roar with the laughing cataracts that rush through the little veins and arteries, and run the mimic mills to feed and paint their gaudy blossoms.

As in vegetable, so in animal existence. Birth, life, death, decay, follow each other to make up the vibration of physical existence with all animate nature. It is difficult to designate a function pertaining to animal life that is beyond the control of these laws. We breathe; respiration is vibratory. Our blood flows in pulsations. All nervous excitation, whatever the sense—sight, hearing, taste, touch; even thought, that highest of all nervous sensations—all these are clearly vibratory in their action. Why, even our organs of locomotion are but vibratory appendages, like the fins of the fishes or the wings of the feathered world.

A clear conception of distance, beyond a limited range, is difficult of accomplishment Even comparison with familiar areas or spaces, when applied to extended intervals, gives but unsatisfactory results. By day we behold the sun which lights and warms the earth from a distance of nearly one hundred millions of miles away. By night we behold the lesser lights, the number of which, including the telescopic stars, is estimated at no less than seventy five millions. Many, very many of these are vastly superior in size to our own sun, which has over one million times the volume of our earth, yet by reason of the great distance of these immense bodies they appear to us as mere points of light.

The dog star, Sirius, the brightest star in the northern heavens, has the volume of sixty of our suns, yet such is its immense distance, about one hundred millions of millions of miles away, its brilliancy is much inferior to that of the planet Venus, which is one-tenth smaller than the earth.

Now, to come back to the sun, the center of our solar system, we see it surrounded by a series of planets, each performing revolutionary vibrations around it, their cycles of movement varying with their varying masses and distances, and these again in many instances carrying with them secondary bodies, each moving with uniformity the most precise, harmony the most complete, and with a grandeur awe-inspiring.

The planet on which we live has each day since its creation whirled in space, completing its diurnal revolution on its axis, and each year its annual movement about the sun, lighted and warmed by vibratory force from that great luminary, held in its position by vibratory law. And the sun, too, revolving upon its axis in about twenty-five and a half of our days, moves in an orbital track about some other sun, carrying with it the entire system of which it is the center; and this again is supposed to be a system dependent upon another, and another, until there is no conceivable limit.

It is beyond the grasp of the human mind until infinity is explainable, until we are enabled to comprehend an existence which has neither beginning nor ending; and all these movements are amenable to gravity, which holds and controls these immense unnumbered masses in space; that sends them forward on their untiring journeys, over paths without tracks, with a uniformity and exactness to excite a feeling of wonder and admiration in the most skeptical human mind. Yet our own solar system has no mean or insignificant proportions when we consider the extended vibrations of comets in their annual revolutions round our sun.

One of these astronomical puzzles, of which the orbital elements were computed by competent authority, requires no less than 3,380 years to complete a single oscillation. When we remember that these wanderers are sometimes accompanied, during a portion of these orbital trips, by an attendant having a lineal measurement greater than the distance from the earth to the sun, we are struck dumb with astonishment and reverence at the immensity of the mechanical movements of these whirling pendulums of God's eternal clock.

Everywhere in nature there exists a substance of infinite elasticity and extreme tenuity, which surrounds the atoms and permeates every so-called solid. It fills all space throughout the universe. This substance is known as luminiferous ether. Vibrations from luminous bodies are taken up by it and transmitted by wave motion. Light is conveyed by it something similarly to the manner in which sound is conveyed by air waves with, however, this marked difference: While sound waves move in one direction those of light move at right angles to this—the former being, in scientific language, longitudinal while the latter are transversal. The mechanical properties of this ether are rather those of a solid than of an air.

The vibrations of this extremely tenuous and elastic substance are, from its very nature, capable of inconceivably rapid movements and, from like causes, it is never at rest. The rays of the sun are brought to us at the rate of about 187,000 miles in a second. Sir John Herschel estimated that a cannon ball would require seventeen years to reach the sun, while light requires but eight minutes to traverse the same distance, and that while the swiftest bird would be nearly three weeks in flying around the world, light would make more than the entire distance for each stroke of its wing.

Light, pure and colorless, as it is given to us, is susceptible of divisibility. Nature does this for us in a most complete manner in the rainbow. Artificially this is done by the triangular prism, giving us the seven hues once known as the primary colors.

The principle which underlies this experiment is this: The different hues have different rates of vibration and different angles of refraction. The prism receives the ray of white light and refracting it, breaks it up into its component parts, throwing the different colors at differing angles, and consequently at varying distances, upon the screen. Following up the result thus obtained led to the discovery of the spectroscope by means of which the component parts of the blazing sun and the light from fixed stars are as perfectly analyzed and recognized as if manipulated in the laboratory of the chemist.

The solar spectrum shows peculiarities aside from colors which, like these, do not extend the entire length of the image on the screen. Beyond the rays which are there visible to the human eye, where all seems colorless and dark, at the one extreme of the spectrum rays powerful for chemical effect are found by the photographer and the chemist, while beyond the opposite or red extremity are found invisible rays of excessive heating power.

The ultra-violet rays, which to us are opaque, have, by late interesting experiments by Sir John Lubbock, proven to be less opaque to some classes of insects, than even the yellow rays We can have no conception of what the ants see in that portion of the spectrum.

Light vibrations, like those of heat and sound, may be deflected from their course. We see the sun, a star, or a candle by its own light, which reaches us in a right line from its source. Were it not for reflection, the light of the sun would be entirely shut off wherever a shadow now exists

Echoes are illustrations of the reflections of sound vibrations. The long rolling thunder in a summer storm, succeeding a flash of lightning from one of nature's condensers, is but the reverberation of sound waves, hurled back and forth from cloud to cloud until silenced by absorption.

The tone of an engine bell, or the whistle of a train you are passing on a railway, rises rapidly to a higher pitch as the trains approach, and sinks again as they separate. The diminishing distance in the first instance increases the number of vibratory waves that strike the ear in a given time, while the receding trains diminish the number impinging upon the listener's ear during the same period, and the pitch of the tone we know depends upon its rate of vibration. The tone of a steam whistle is often varied by the engineer, who gradually opens and closes the valve, thus increasing the vibratory rate or decreasing it, sometimes carrying the whistle tone nearly or quite through an octave.

Vibrations may be absorbed. It is to this fact that we are indebted for the hues of all nature's beauty by field and hill, by glade and stream, where but for this provision all would be tiresomely similar and somber. This peculiarity of vibrations is made available by musicians in the use of the soft pedal of the piano, and the mute on the cornet. In the acoustic telephone you all know how carefully the sound insulators must be adjusted to prevent the deadening of the vibrations, and so make even a tolerable success of it. Heat vibrations are readily disseminated and dissipated by absorption; vibratory waves moving rapidly or slowly according to the relative capacities of the source and the recipient.

Some recently published results of experiments by that eminent scientist, Chas. W. Siemens, with the electric light as an aid to vegetation, are interesting from this point of view.

These experiments extended over a period covering considerably more than a twelvemonth, both inside a greenhouse and in the open air. It soon became apparent that the open air plants, which received the light rays through the glass forming the frame of the lamp, were far more thrifty and in better general condition than those under cover which were exposed to a naked light

The first attempted explanation of this fact was the assumption that the increased production of nitrogenous and carbonic compounds was in excess of the needs of the plants, and so acted destructively. All attempts, however to remove the difficulty, by ventilation and otherwise, proved futile. Finally, a clear glass globe was placed around the light and an almost marvelous change occurred in a single night. A sheet of glass was then placed so as to intercept the rays from one portion of the plant, while other parts of the same plant received the free rays. In

[1] By request read before the Chicago Electric club, Oct. 29, 1888.

twelve hours a distinct line of demarkation showed where the two sets of rays joined—and yet this difference was only the result of the interception of a thin sheet of clear, uncolored glass. So far as the eye could detect, no light was absorbed, nor was its color perceptibly changed, and yet a decided advantage was gained by passing the rays through this thin transparent medium.

Following up the hint thus arrived at, the learned investigator arranged the conservatory so as to submit different portions of this to the action of light transmitted through blue, red, yellow and transparent glass, and the uninterrupted rays direct from the lamp.

Under the clear glass the most satisfactory growth was induced. Next in the order of success came the yellow; the red light produced a spindling growth with sickly yellowish leaves, while the blue exaggerated these results; and the naked light, least successful of all, produced a dark and partly shriveled growth of foliage.

Now, in all these experiments, to the absorption of invisible rays, the arresting of the vibrations of some part of the beams of light from the electric arc, are due the curious and marked results obtained.

The air surrounding us is in constant vibration. Heat, light, sound, are constantly disturbing and varying its condition. The sound of my voice, originating in a muscular movement of the throat, is carried by the wave motion there communicated to the air, and thence to the uttermost parts of the room, with comparatively little effort. Yet, in doing this, I am effecting a sensible mechanical result on a gaseous body exerting a mechanical pressure of fifteen pounds to the square inch in every direction. These vibrations are sufficiently low in their rate of movement to produce an effect on the auditory nerve of the human ear.

Man has been classified by some satirist as a "two-legged boasting animal," and education has taught us to believe that the human race is superior, in every respect, to the so-called inferior creations of nature We claim to be nearer, in every way, to the great Creator of the world, and highest in the scale of God's handiwork.

We are saved from mortification and exposure by the fact that the power of speech, that is language which we can interpret, has been denied to the rest of the animal world. Could they but speak to us in our language, or could we but translate theirs, they would tell us of sound vibrations so rapid that the dull ear of humanity is incapable of receiving them.

The range of vibrations which are appreciable to the human ear is limited between sixteen and forty thousand per second. That is, a vibration which completes sixteen cycles in a second, or more rapidly until it accomplishes forty thousand in the same period of time, is, save in anomalous instances, appreciable to the human ear; and these limits embrace the rates of vibrations of all appreciable sounds. Above or below these, to man, all is silence.

With an instrument similar to the siren, specially constructed for the purpose, Sir John Lubbock created the utmost consternation among the animals of a zoological collection and killed great numbers of insects, while no noise was heard by those standing near the instrument, nor was any disturbance experienced from its action. The rate of its vibrations required a more delicate nerve organization than we are possessed of, to recognize their presence.

Perkins, the inventor of the steam gun, without recognizing the fact, arrived at the same result, namely, the production of rates of vibration above the capacity of the human ear, in the course of his experiments with steam in a high state of tension, from the standpoint of the phenomena of boiler explosions

In a boiler of sufficient thickness and strength to secure perfect immunity from explosion, be drilled a hole not larger than a fine needle. He applied gradually increasing heat beneath this boiler until it reached the highest point attainable by the means at his command As the heat increased these phenomena presented themselves in the order named. At first, vapor exuded from the minute orifice, then white, followed by blue steam, accompanied by hissing, succeeded by a low whistle. The sound increased in both force and shrillness, rising finally to an almost deafening shriek which the experimenter says could be heard a mile Then the sound grew gradually fainter until silence ensued, the quantity of visible steam decreasing until neither sound nor steam were appreciable, but the circumference of the orifice became hotter and eventually assumed a bright cherry-red color. The rate of audible vibrations had been passed and some of these were now being reconverted into heat in their passage. The source of heat was now removed and the various results were again arrived at, but in an inverted order of succession.

Had Perkins been investigating vibratory law, instead of boiler explosions, he would doubtless have seized upon these capital illustrations of the conservation of energy.

His theory of the silence and the non-issuance of steam at the point of greatest pressure was, that the heat had, by expanding the steam particles, so enlarged these that they were unable to pass the orifice which had become partially closed by the expansion of the metal surrounding it.

The human eye compares no better with those of a lower animal creation. The birds, many of them, and especially those of the family to which eagles, hawks and vultures belong, are furnished with telescopic eyes, by which variations of distance—to what extent we know not, but we do know they are great - are almost instantaneously compensated for by focal changes in the eye.

I have seen a hawk dive from the top of a high tree and seize a mouse upon the ground quite near me, before the latter could reach a hiding place ten feet from its nest which I had just overturned; and yet from that bird's lookout to me was a distance so great, I much doubt if I could have seen a squirrel to recognize it with certainty

Some one has said, in substance, of the human eye, that it answered very well for want of a better, but that an optician who would call attention to a specimen of his work which combined so many imperfections as the best human eye always includes, would lose, rather than gain by his advertisement.

The "eyes of science," as Proctor has so aptly designated those optical appliances, the microscope, the telescope, the camera, and others, are far more perfect in many regards than those combinations of lenses nature has furnished to humanity. The human eye is impressed instantly, but it ordinarily requires about one-sixth of a second to lose the perfect impression of any object, and this persistence of vision blurs by interference the next subsequent impression.

A meteor in the sky is to us, in its rapid movements, a luminous line, while we know that its form is globular. A sky-rocket produces much the same impression, and a fire-wheel, after its pyrotechnic fires are extinct, still shows a ring of fire, while its motion is dying down, if the case has but a spark upon it. Sparks from burning charcoal, or from a chimney, are streaks of fire; and a discharge from a Holtz machine, like that from one of nature's larger accumulators, is ever a streak of lightning. The spokes of a carriage wheel are blended in rapid motion and the wheel assumes the appearance of a disc, while the action of a horse, at a rapid pace, is never well defined by the retina, except where an instantaneous illumination is followed by absolute darkness. Yet the camera of the photographer is competent to catch and preserve the attitude of the swiftest moving animal. Perfect representations of the fleetest racers have been thus secured with a plate exposure of such short duration that the entire animal has been pictured in the air, not one foot touching the ground.

Photographs of the sun have latterly been taken so nearly instantaneously as to show details impossible of procurement by any other method, and which, of course, had never been known before.

And the eye of science is equally superior to the human organ in other important regards. Without wearying, without even winking, it will hold its unflinching gaze, as in the case of photographing nebulæ, where two or three hours are required to fix an impression of these faint bodies; and this, too, while most ingenious apparatus is required in combination with it to compensate its visual direction for the complicated movements of the earth, during the long exposure.

In various portions of the world are found caves, the waters of which are inhabited by sightless fish—creatures possessed of only rudimentary eyes—in other words, so imperfect is their visual organism that to all intents and purposes they are totally blind. The light of day never reaches them, yet they are capable of finding their proper food, escaping from danger, hiding or fleeing when pursued; in short, accomplishing their fish destiny in much the same manner and apparently with as much success as their more fortunate and higher developed cousins in the waters above ground.

Some experiments made with specimens of these fish showed interesting results. They were confined in an aquarium in which was placed a considerable quantity of ragged rock, selected and arranged to form the best possible dark-hiding places and thus adapt their forced existence, as nearly as might be, to their natural requirements.

It was noticed that in all their movements they passed freely back and forth, around and among the rocks, without hesitation, even when suddenly startled by concussions, noises, etc., and they were found to be extremely sensitive to the least disturbance. Touching the water never so lightly with a broom-straw caused them to hide at once.

A fish of a different variety, but possessed of perfect vision, was procured and placed in the aquarium, when immediately a new series of phenomena presented themselves As the strange fish struck the water, the poor blind creatures, instead of shrinking with fear and seeking a hiding place, at once assumed the offensive and gave chase to the intruder, who fled, evidently conscious of danger. It practiced all the knowledge it possessed in doubling and turning the angles and threading the intricate passages among the rocks, and was closely followed until overtaken and destroyed by its sightless enemy. In all this chase the track was never lost, the threatening projections of rock were evaded as readily by the pursuers as by the pursued, and no evidence was adduced to indicate that the one had not visual powers as perfect as the other.

Now, vibration, in some form, guided these sightless creatures in the pursuit of the intruder. Whether those pertaining to smell, or feeling, or sound, we know not we can only conjecture.

A blind man, one who from birth, or for many years has been deprived of sight, is to some extent compensated for his lack of vision by increased sensitiveness of other faculties; but these never reach the perfection shown in the experiment mentioned.

The brain, in the higher developed types of animate nature, we consider the seat of the mind, of thought, of that will-power which controls, through a system of vibratory nerve telegraph, all physical action. Physiologists tell us that at this center of life action the record is made of all outward impressions

In telephonic parlance, it is a sort of central office, whence all responses are made, and to which all calls are sent. These delicate lines are no more wonderful than varied in their capacities and adaptations to rates of vibratory action, each within its own range or sphere.

The auditory nerve, divided into some three thousand harp strings, is incapable of receiving impressions from finer vibrations than those pertaining to sound. The delicate organism of the inner ear may be injured so that ordinary audition is impossible, yet, if the little harp be intact, the proper rates of vibration may be communicated to and received by it through other nerves which lie in the immediate neighborhood. A deaf person may often be made to hear the twanging of a stretched cord or wire, one extremity of which is held in the teeth. The sound is communicated through the bones of the head to the inner ear. The audiphone held to the face or any fleshy part of the person will give no result, and it is valueless to those whose teeth are "marvels of art." Nor will the audiphone accept the lower jaw as even a passing good substitute, for the mechanical separation of this from the head bones interposes at the joint an imperfect conductor.

Pungent odors often produce marked effect on the pneumogastric nerves, while a derangement of these latter may sometimes produce an effect upon the olfactories. In all these cases the vibratory effects are secondary rather than primary in their nature and power.

In the lower animal organisms, though no brain, as such, is found, there still exists, for all the requirements of these less perfect creations, a system of mental action by which all needs are provided for. Fear, hunger, the baser passions, maternal instincts, etc., are more or less perfectly developed.

Still farther down the scale we find in vegetable life, action which so closely approaches to that of scientific life as almost to obliterate the dividing line between the two. An acorn, starting on its life journey, finds itself opposed by unpropitious circumstances. The soil is unfavorable—a rock impedes its progress. The weakly little shoot, deterred by nothing, sends out its tiny rootlets, downward or laterally, as the case requires, but always in the right direction, in search of the proper nourishment. The plant root is a faithful, honest commissary. Prevailing winds threaten its overthrow when the little oak has attained to respectable dimensions, and now it displays the talent of its engineer, throwing out strong, bracing roots, yet always in the proper direction, to prevent the threatened disaster.

See the fruit-bearing tree in the blooming season. Could every flower there become a perfect fruit death would inevitably ensue from the ill-proportioned weight on the boughs. What is the remedy? The tree, as if it reasoned with itself, seems to say: "I have provided for accidents which have not befallen me and I have now a greater call upon my energies than is safe for my health and the good of my offspring." It dooms certain of the germs to destruction There is no law against infanticide in nature, and the condemned, deprived of the requisite nourishment, wither and fall. Again and again, during the season, does the tree enact the several roles of accuser, judge and executioner, until it has decided what shall finally remain, and then the work of growth and ripening goes on swimmingly. It is true there are occasional mistakes made, more being undertaken than can be carried to a successful conclusion, or less than an average number of germs retained. In the former case the rule of the greatest good to the greatest number is adopted, while in the latter everything is done for the few; quality and perfection being the apology for meager quantity.

Trees make mistakes as well as men, but trees have no brains.

Minute differences in vibratory rates are capable of producing most striking results. In musical tones, doubling the rate of vibration invariably raises the tone one octave, and every increase or decrease of the vibratory rate of a tone changes its pitch proportionately. But the same absolute pitch sounded upon two different instruments produces entirely distinct impressions upon the ear. Why? Because of the overtones, the combinations of minor vibrations, which are ever the accompaniment of any tone. These minor vibrations are combined in different proportions in different sound sources A silver flute has not the same tone as one of wood, and the clarionet is unlike the violin in the quality of its tone. This quality of tone is almost endless in the variety which it permits in music. But material has not alone the control of this peculiarity of tone quality. Form has much influence It lies at the bottom of those differences in the human voice by which we are enabled to select musical or unmusical vocal efforts By the quality of a voice we may recognize an acquaintance in the dark, even after years of separation.

A careful study of the quality of the human voice is as necessary in the selection of a vocal band as is the quality combination in an aggregation of instrumental musicians. The fewer the number, too, the more apparent will be the want of that finer harmony, the pleasing effect of properly selected quality in the voices or instruments, if this study is neglected. Understand, I do not speak now of the ability to correctly reproduce every note, but a capacity to make these notes so produced blend harmoniously as a whole.

The finest singer, in advancing years, may, while retaining all the accomplished knowledge which education and practice have wrought be very unmusical in vocal effort by reason of a changed quality of voice.

Another marked result in music is chargeable to these overtones or sub-vibrations. Musical instruments are imperfect in their construction. Theoretically we assume that the scale is made up of a certain number of steps or tones or half steps and half-tones, and that certain differences in the number of vibrations will produce a note or a half-note above or below a given tone. But you who have been compelled to listen to a piano or organ tuner know that he is a longer time at his work than would seem necessary were this the fact. Practically, there are a certain number of vibrations which he is compelled to distribute throughout the entire length of the keyboard, the result of which is that the tone steps are not of equal length, nor is the same number of vibrations added or deducted to produce a half-step. It is to this difference in the intervals which assigns bold, martial music to the sharp keys, while plaintive, gentler strains are found better adapted to the flat keys. Any pianist who will play the Star Spangled Banner, for instance, alternately in two sharps and four flats will, I think, readily comprehend this difference. We are thus enabled to accomplish far greater variety in music than would be attainable were these distances between notes uniform in extent.

There are minute vibrations which result in changing the molecular distances of fluids, forcing these asunder and causing evaporation. Noxious smells are created in a somewhat similar manner as well as perfumes, and the distinctive odors of animals and insects, by which they recognize and trace each other.

It is related of a dog, who had long been the constant companion of a horse, that, being separated from the latter animal for a time, accidentally crossed his track, and recognizing the scent, immediately followed and overtook his old friend.

The foxhound, trained for hunting, will only follow the

trail of the fox under any circumstances. I have been told by an old hunter that these animals have been known to follow a fox track in a line parallel to it, many rods away, with a favorable wind blowing toward them, for long distances. This delicate appreciation of distance by the strength of the scent is something of which humanity can have no adequate conception until we are educated up to the olfactory capacity of a foxhound.

Vibratory sensation is capable of development. Practice in the microscopist gives him a power of vision which the uninitiated little dreams of. The piano tuner will discover an inharmonious element in a musical chord, which to another would be utterly unappreciable. The tea taster will detect a shade of flavor or value between samples which to the uneducated would be precisely similar. The physician readily recognizes the odors of diseases, in some instances, when these are sufficiently concentrated, but when the vibratory antagonism of the molecules of these have separated them until there is no more than the highest homœopathic attenuation of the atmosphere, there may still remain sufficient of both quantity and intensity to reproduce the parent disease.

I may be chimerical, but I believe the day will come in the not distant future, when the ingenuity of man, through the patient plodding of some hard worker in the still rich fields of vibratory law, will mark the rates of perfumes and odors, and tabulate the vibrations of disease germs as perfectly as we now count the vibrations of sound and light. How this may be accomplished I know not; it lies in the dark future; but the discovery and its application will be no more wonderful than the development of the spectroscope which tells us of the fires in the sun, which names the metals in a glowing fire a hundred millions of miles away in space, which names to us in language that any scientist in any land may read—in nature's own tongue—the fuel in glowing suns sixty times larger than our own, by analyzing to-day a ray of light that left its source years ago, and which tells us whether different suns are traveling toward or retreating from our own solar system.

Look at the record of the past hundred years, and noting the progress of science, ask yourself if this is to-day more distant than was the telegraph, the telephone, the induction coil, or the electric light, a century ago.

One curious thought in all this study of vibratory law obtrudes itself upon our attention, and is worthy of note here. Nowhere has man invented a mechanical motion which is not more or less directly a reproduction of one of nature's own. Reciprocating motion? It is found in the molecular movements of particles. Rotary motions have their prototypes in winds, in the movements of vapors, in the orbits of the heavenly bodies, and in their diurnal revolutions.

The swinging bough and the waving grain are repeated in the pendulum—the true type of all excursionary motion. The Leyden jar, the condenser, and the induction coil are thunder clouds in miniature, and the electric light is but a continuous stream of lightning, while the Geissler tube contains but a pocket sample of Aurora Borealis, put up air-tight for home consumption.

Vibratory law lies at the very bottom of all vegetable and animal life. To it we are indebted for all that is beautiful in art and in nature. It gives us all our magnetic and electrical action It actuates our telegraphs and our telephones, the fire alarm and the electric light. Our batteries would be powerless without it. Nay, more; without these minute movements, which pervade the entire universe, there would be neither heat, nor light, nor color. The stars would cease to shine, and the sun would be a blank, invisible. The earth would refuse to move; all sound would cease; darkness and death and chaos would instantly succeed to the present beautiful creation.

Before the reading of the paper the minutes of the previous meeting were read and approved. Treasurer Terry's report was read and was ordered filed. Thomas Addison of the United States company and George H. Mayo of the Van Depoele company were admitted to membership B. E. Sunny, chairman of the committee and electric exchange, said he expected to present a report at the next meeting, November 19th.

At the conclusion of the paper the discussion was opened by H. Ward Leonard. He said he had been much interested in an article which related to the experiments of Hertz, in Germany. It had been demonstrated that electro magnetism should be included among vibratory phenomena. Hertz had constructed a current whose period of vibration for electric currents was the same as his generating vibrator and he was able to see sparks due to the induced vibration leaping across a small air space In this connection Mr Leonard said the phonograph was an instrument of great interest. It had been said that the ear was capable of detecting vibrations only between the limits of 16 and 40,000 per second. By means of the phonograph vibrations outside of these limits could be recorded. By running the reproducer at higher than the ordinary speed, vibrations of less than 16 per second could be made audible, and by running slower than the normal speed vibrations of more than 40,000 per second could be detected He thought this would be a wide and interesting field for the phonograph.

George Cutler, Dr. De Bausset and Mr. Kedzie spoke briefly on the subject.

The Chicago office of the Fort Wayne Jenney Electric Light company has contracted with Swift & Co. for 1,000 sixteen candle power alternating lights for their Chicago establishment, and 600 lights for their Omaha establishment, and with the Grinnell, Ia., Electric Light company for 600 lights.

Mrs. Bliffers: "An agent for a new burglar alarm was here to-day, and I told him to call again when you were at home." Mr. Bliffers: "Huh! Burglar alarms! There is nothing in this house to steal." "No, but when the neighbors hear we have fitted up our house with burglar alarms they will think we have something to steal, my dear."—*Philadelphia Record.*

CORRESPONDENCE.

New York Notes.

NEW YORK, October 25.—The removal of the complications which have existed regarding the right of way for the Bentley-Knight, Fulton street railway in this city, is expected to lead to its immediate completion. The track has been laid for some months, but the Bleecker street railway obstructed its completion until this week, when an agreement was signed by which the work will be permitted to go on. This is a very important step in electric railway progress, and every well-wisher of the general electrical cause should hope for its unqualified success, as the road will be operated through one of the most important business centers of the city, where its success or failure will be carefully watched by the press. There will be a combination of curves and grades, obstructed and dirty streets, and apparently about all of the possible obstacles which can be imagined. If operated satisfactorily the line should yield a large revenue, although by the terms of the franchise a large proportion of it will go into the city treasury.

At the meeting of the Board of Electrical Control on the 23d Engineer Kearney was called upon to report as to his investigations of the complaint made by the Western Union Telegraph company that the insulation of some of their underground cables had been destroyed by the excessive heat from the adjacent pipes of the steam heating company. The engineer reported progress, and said that Broadway had been opened at Exchange place to repair a break 13 feet below the surface, and excavations made about 75 feet in each direction. Many defective joints had been found which were being packed with lead and rimmed with iron as rapidly as possible. The dirt was found to be so hot in places that it could not be handled. There is a big leak elsewhere which caused the damage to the wires. The telegraph company experienced this same difficulty years ago, but with gutta percha insulation which melts at a much lower temperature than the insulations now used, it was hoped that no more trouble would be experienced. It now appears doubtful that any insulation in use will stand the heat to which the cables are liable to be exposed in the vicinity of the steam heating pipes. On motion of Mr. Gibbens it was voted to send a notice to the Bureau of Incumbrances to remove certain poles erected by the Mount Morris Electric Light company without the authority of the board. The company was also declared to be in contempt until it had explained its operations satisfactorily to the board.

The Board of Estimate and Appropriation met on the 24th and allowed an appropriation of $693,500 for lamps, gas and electric lighting, $706,000 having been asked. Application for $31,400 having been cut down by $1,900, for the removal of street obstructions, General Newton remarked that there were 40,000 telegraph poles which would have to be removed at a cost of $4 each. Mayor Hewitt asked if any member of the board would move for an appropriation of $160,000 to clear them away. Nobody made such a motion, whereupon his honor remarked: "Now you see, gentlemen, that I am powerless to remove the poles."

The first graphophone to be practically applied to office work in this city has been set up in the office of Lowrey, Stone & Auerbach in the Mills building. It was placed in the room set apart for stenographers and typewriters. The lawyers of the firm expect to dictate their correspondence to the machine and have it reproduced on the typewriter.

The National Board of Steam Navigation met at the Fifth avenue hotel on the 23d in annual convention. President Cheney read his report and a general discussion ensued regarding the electric lights along the water front and on the Brooklyn bridge. They were informally condemned as being dangerous to navigation. It might be in order for them at the same time to condemn the existing clumsy system of signaling in vogue which permits a vessel to be run down in broad daylight, as was the case with a steamer of the Atlas line at the foot of Cortlandt street on Tuesday of this week.

The right, title and interest of the American Graphic company, publishers of the daily *Graphic* in this city, were sold at auction on Wednesday to pay unsettled judgments against the corporation, for rent and supplies. The purchasers were the Southern Trust company, composed mainly of persons now concerned in the *Graphic* company. The price paid was $5,000. The sale will have no effect on the business of the company or the editorial management of the paper, which has been for some time under the charge of Edwards H. Goff, formerly of the American Electric Manufacturing company.

A delegation from the Gas Consumers' association waited on Senator F. Reilly on the 24th and presented him a set of resolutions in which they thanked him warmly for the successful fight he had waged against the gas companies in their behalf, by which the price of gas was reduced 50 cents per 1,000 feet, resulting in a saving of $3,000,000 per year to the gas consumers of the city. They also pledged themselves to give him their support as a candidate for the office of county clerk.

President Battin of the Essex Passenger railway in Newark, N. J., has returned from an inspection of the electric railway at Wilmington, Del., and expresses himself as strongly in favor of the electric system, as was President Radel of the South Orange road, when he came from Richmond. Mr. Battin favors trying the overhead system on the Bloomfield line, and will bring the subject before the board of directors immediately. P.

St. Louis, Mo.

ST. LOUIS, Oct. 27.—St. Louis is soon to have an electrical club. The hall of the Marine Engineers' association will be used as a meeting place until the society can find permanent quarters. The society extends a cordial welcome to all engaged in electrical pursuits, to join it.

The St. Louis exposition is over. During the exposition Professors Gale and Jones of Washington university, and S. P. Baird, electrical and mechanical engineer of this city, made a competitive test of Russell, Buckeye, and Dick & Church automatic engines. The test was very thorough, and the results will be interesting.

The St. Louis Western Electric Light company has increased its capacity by adding two 35 light dynamos and 70 lamps. This addition makes a total capacity of 295 lights, nearly all of which are burning at present. The company has just put in, under the direction of their electrician, Elmer Edwards, a new switch-board of the Western Electric company's make. It is one of the finest boards in the city, and has a capacity of 15 machines, and as many circuits.

The Electrical Merchandise company, at the corner of Second and Locust streets, is enlarging its works preparatory to building incandescent machines.

The Electrical Accumulator company will install batteries in the Bank of Commerce building, and in the Laclede building.

The St. Louis Electric Power company will add three motors to its cicuit this week.

G. J. Percival has closed a contract with the Missouri Pacific Railroad company to equip one of its coal mines with electric motors. The Thone motor will be used. Mr. Percival also reports the sale of a 10 light arc machine to the Gascon Electric Headlight company of Sparta, Ill.

The St. Louis Illuminating company, operating the Heisler system of long distance incandescent lighting, has received its new 14x20 Russell engine, and will soon have it running.

C. C. Radebaugh of the Vincennes Electric Light company, has been in the city for a few days.

S. P. Baird is making a specialty of armature repairing. B.

Indianapolis, Ind.

INDIANAPOLIS, Oct. 27.—The Merchants' Electric Light & Power company, mentioned in last week's letter, has completed its organization, and filed articles of incorporation with the secretary of state. The capital stock is $100,000, of which over half has already been subscribed. R. T. McDonald of the Fort Wayne Jenney company is one of the heaviest stockholders.

The ordinance providing for the regulation of the construction of wires for incandescent electric lights had been made the special order in the board of aldermen, October 25th, but consideration was deferred two weeks. It is understood that an ordinance is being prepared by which all electric wires, incandescent and arc, are to be put under ground under certain limitations. Some of the city fathers are not able to stomach the discrimination of the ordinance which has passed the council compelling only incandescent companies to bury wires.

Charles Campbell, an employe of the Brush Electric Light company, was badly injured while trimming poles, his axe glancing and going deep into one of his legs. M.

Dallas, Tex.

DALLAS, Tex., Oct. 24.—The following bids have been made for lighting the city:

Dallas City Gaslight company: For the number of street lamps now located per lamp per annum:

Moonlight schedule, 4-feet burner, $20; 5-feet burner, $24; 6-feet burner, $28.

All-night schedule: Four-feet burner, $28; 5-feet burner, $32; 6-feet burner, $36. Additional lamps at the above rates, if three years' contract; and if a year's contract, the actual cost of the erection of such lamps to be added.

The Electric Light & Power Manufacturing company: Fifty arc lamps, 2,000 candle power, per annum, moonlight

schedule. $100 each; all night, $125 each; 75 arc lamps, moonlight schedule, $90 each; all night, $112.50 each; 100 arc lamps, moonlight schedule, $85 each; all night, $106.25 each. Additional arc lamps at the above rates.

The Queen City Electric Light & Power company: Fifty arc lamps, 2,000 candle power, per annum, moonlight schedule, $83.95 each; all night, $95.85 each; 75 arc lamps, moonlight schedule, $83.95 each; all night, $95.85 each; 100 arc lamps, moonlight schedule, $83.95 each; all night, $95.85. Additional lamps at the above rates. Incandescent lights each per annum: Sixteen candle power, moonlight schedule, $30; all night, $35; 32 candle power, each per annum, moonlight schedule, $55; all night, $68. C.

Cincinnati, O.

CINCINNATI, O., Oct. 27.—Acting under the resolution adopted by the Board of Public Works on September 24th, 1885, granting the Cincinnati Inclined Plane Railway company the right to use electricity as a motive power on their line, M. J. O'Conner, the general manager, has made a request of the Board of Public Affairs for a permit to erect the necessary poles, wires, etc., and to change the grades and curves from Liberty street to the Zoological gardens. This was referred to the committee on grades, improvements and railways. James Doherty, who has heretofore been the general superintendent and business manager, was seen, and was asked concerning the future of the road, which is better known as the Main Street line. He said: "It is intended first to change the inclined plane so as to carry cars continuously over it upon platforms; second, to relay the road from Liberty street north to the Zoological garden with a heavy girder rail, admitting of high speed, and to fit the whole line with the best and most approved electrical system; with engines, cars, and all equipments to put the line on the full front of modern progress, second to none in the country.

"It is believed that the electrical system of car propulsion has reached a stage where it can safely be adopted by companies, and permitted by the public upon the most important streets, and as soon as the Board of Public Affairs acts upon our application work will be begun and pushed energetically, giving us very soon a line of double track electrical road from the center of the city, upon almost a straight line to the Zoological garden gate, which will add greatly to the prosperity of the 'Zoo,' and I feel sure satisfy the public." A.

THE ELECTRIC LIGHT.

Concordia, Kan., is to have an electric light plant.

Citizens of Marceline, Mo., are delighted over the prospect of an electric light plant.

The authorities of Victoria, Tex., are contemplating the purchase of an electric light plant.

The Paducah Gaslight company of Paducah, Ky., has recently enlarged its Brush arc light plant.

Handley & Glenn of Dalles, Ore., have ordered a 35 arc light plant of the Thomson-Houston company of Chicago.

The Van Depoele company of Chicago is contemplating the advisability of putting an alternating system on the market.

John Wanamaker of Philadelphia has just contracted for a 500 light Brush-Swan plant for the lighting of his country residence.

The Ravenna, O., Gas Light & Coke company have ordered a 35 arc light plant of the Thomson-Houston company of Chicago.

The plant of the Columbia, Ga., Electric Light company is nearly ready for operation. Within a few weeks the city will be lighted by electricity.

The A. Eilers Montana Smelting company of Great Falls, Montana, have ordered a 30 light arc plant of the Thomson-Houston company.

The Boulder Electric Light company of Boulder, Col., have ordered a 400 light incandescent plant of the Thomson-Houston company, Chicago

An election was held at Slater, Mo., recently to decide whether an increased tax should be levied for the purpose of putting in electric lights, and was carried by an overwhelming majority.

At the fetes held recently in honor of the opening of a new science and art institute at Walsall, England, a game of football was played at night, by electric light, in the presence of 7,000 persons.

The electric light company, says the Hastings, Neb., *Nebraskan*, is making many improvements in the plant, and the light is being used in private residences. As a motive power electricity is coming to the front in Hastings also.

The entire iron front of a Carrollton, Mo., saloon became charged with electricity during a recent rain storm. The current escaped from an electric light wire. After several thirsty individuals had been shocked, the cause was discovered.

The American Wire company of Cleveland, O., has recently purchased from the Brush Electric company of the same city, a plant having a capacity of 45 1,200 candle power arc lights and 75 16 candle power Swan incandescent lamps.

The Sioux City Engine works of Sioux City, Neb., has recently sold two 75 horse power Corliss steam plants for electric lighting purposes, one to James Bell of David City, Neb., and the other to the Storm Lake Electric Lighting company of Storm Lake, Ia.

The Brush Electric company, Cleveland, Ohio, has sold to Perry Bros. of Detroit, Mich., through the Brush Electric Light company of Detroit an incandescent electric light plant consisting of an 150-light incandescent dynamo with full complement of lamps.

The Davenport, Ia., Central Railway company is supplying a number of incandescent lights from its stationary power circuits. The economy of operating a station of this kind will be readily understood when it is considered that the company supplies light, stationary power, and operates the railway from the one power house. The Sprague system is used.

The 300 light incandescent plant installed by the Silvey Electric company for the Ada Electric Light company, Ada, O., about a month ago, is to be increased to 600 light capacity as soon as the larger dynamos can be put in. There are 36 and 100 candle power lamps to be used in the plant. Twenty-five additional Silvey arc lamps are also to be put in for lighting the streets.

The New York park commissioners last week ordered the Brush Electric Light company to remove the tall poles at Madison and Union Square parks that used to support the cluster of electric lights. The commissioners said that the cluster of high lights had been found unsatisfactory, owing to the shadows cast by the foliage beneath them, and that lights on short poles were hereafter to be used

The contract for lighting the large new steamer Puritan of the Fall River line, which will run between New York and Fall River, has been awarded to the Edison Company through their New York agent, C. A. Benton. There will be 1,600 lamps of 16 candle power each, for which current will be furnished by four 400 light dynamos. Two "Straight Line" engines, furnished through Williams & Potter, New York, will be the motive power for the plant. The steamers Bristol, Providence and Pilgrim of this line are also lighted by the Edison system, the Armington & Sims engine being used as driving power.

Mayor Hamilton of Toledo has signed the resolutions which provide for the lighting of the city by electric light. He did not sign the resolutions just as they came to him from the council, but modified them so as to give to the city the authority of saying in what manner poles should be erected and wires strung. The two companies have approved this modification, and the resolutions are therefore in active force. The electric companies will begin work at once on their plants. To complete the circuit and locate the 300 or more lamps, it will require an expenditure of about $75,000, and it will take a large force of men to finish the work in sixty days, as contemplated. Mayor Hamilton estimated the cost of lighting under these contracts at about $34,000 which does not vary much from the cost of lighting by gas. A Toledo paper says: "The people of Toledo are to be congratulated on having at last escaped the gas bondage."

Talk about something new under the sun, says the Cincinnati *Times-Star*. There was something done at the centennial yesterday that has never been attempted before, let alone accomplished. For it was something that was declared impossible on the face of it. Think of an incandescent light, frozen in ice and burning! This feat was accomplished by F. P. Adams, of the Jenney Electric company of Indianapolis. The ice was frozen by the Cincinnati Ice company. While the process of freezing was proceeding various colored aniline dyes were put in and the most beautiful effects in color and formations produced, and then there was the glass bulb, that we are all so familiar with, with its filmy trace of wire, upon which the electric current flashed and glowed at the will of the operator. Of course some heat is generated by the light, and to think of freezing it in a solid chunk of ice and not cracking the glass, and the electric light burning successfully, seems more like a miracle than a human accomplishment. It attracted thousands. Mr. Adams was warmly congratulated.

Says a London correspondent of provincial papers: "I happened to be in the palace of Sinaia when the electric light was being exhibited to the king on trial. The representative of the English firm who was setting up the installation was an exceedingly voluble person, and he was explaining to his majesty at great length all the advantages which the electric light enjoyed over gas. It did not tarnish gilt, it did not consume or vitiate the air, it could be turned on or off at any moment; there was no occasion to use matches, and greatest advantage of all, it minimized the chances of fire, and absolutely gave out no heat. The king listened with great attention, and was evidently much impressed, but just as the voluble gentleman was mentioning the fact about there being no heat, he placed his hand at the bottom of one of the lamps, and even the royal presence could not restrain an exclamation of pain—he had burnt his fingers with the heated metal. Seeing this, the king gingerly touched the lamp in turn, and he, too, got a slight burn. He smiled grimly, and turning to the electrician, said, 'Hum, well, I hope, Mr. ——, all the other advantages of the electric light are not so apocryphal as this.' But he decided to have it installed, all the same."

A new pattern continuous current transformer and a new multipolar dynamo, both of which are the invention of M. Hoho, have just arrived at the Brussels exhibition, and will compete in the trials coming off next month, says a correspondent. The main feature is an armature with windings. The field magnets are shunt-wound, and to avoid the employment of a high tension current to excite the field, the shunt is taken off the secondary circuit. Under these circumstances, however, the generation of the magnetic field would demand an interval of time, during which the primary current would be excessive. M. Hoho has therefore wound a few turns in series with the primary circuit, and thereby obtained an initial excitation. This transformer seems likely to be very applicable to long distance transmission and especially so to the transmission of power for charging accumulators and working motors. M. Hoho's multipolar dynamo is a four-pole machine, with pole pieces embracing the armature very completely. From a mechanical standpoint the machine is remarkable for its strength and solidity, arising from the compactness of the field. The machine exhibited is compound-wound, and has an output of 8,000 watts—100 volts and 80 amperes—at 1,400 revolutions a minute, its total weight, including everything, being 405 kilogrammes, which is about equal to 10 watts per pound.

The general term of the Supreme court of New York has recently handed down a decision in favor of the defendant in an action instituted by Charles Hequembourg against the city of Dunkirk, N. Y. The suit was brought to secure an injunction restraining the city from purchasing an electric light plant. Last winter the New York legislature passed an enabling act authorizing the common council of Dunkirk to buy a plant. The act became a law without the governor's signature. Mr. Hequembourg alleged that the bill was unconstitutional. The plaintiff was defeated on the trial in the Supreme court, and also in his appeal to the general term The plant of the city consists of 60 Western Electric arc lamps.

THE ELECTRIC MOTOR.

W. W. Monroe of the Baxter Motor company, Chicago, reports that he has installed motors in seventeen cities.

The Broadway Street Car Company of St. Louis expects to have its electric branch road ready for trial by December 1st.

Work has been commenced on the Thomson-Houston electric road at Ottawa, Ill., and the road is progressing rapidly.

Cars will be running about the middle of December on the electric road which the Thomson-Houston company of Chicago is installing at Alliance, O.

The Decatur, Ill., Electric Street Railway company has been incorporated; capital stock, $100,000; incorporators, E. T. Martin, C. M. Barclay and F. Sargent.

A very large increase in the motor business is predicted for Chicago. It is likely that contracts for running high speed elevators by electric motors will soon be let.

Work has been begun on the power house for the electric road to be installed at Topeka, Kan., by the Thomson-Houston company of Chicago. Corliss engines will be purchased, and the plant will be complete in every detail.

The Sprague Electric Equipment company of Chicago is installing on the lines of the East Cleveland Street Railway company, Euclid avenue and Cedar street, Cleveland, overhead wires for the operation of the road by the Sprague system.

The Lafayette, Ind., Electric Street Railway company has recently placed upon its stationary power circuit one 2 horse power and one 5 horse power motors The company has under contemplation the supplying of 45 horse power to a flour mill.

The C. & C Electric Motor company of New York, through the kindness of the corporation of Trinity parish in New York city, gave an exhibition October 23d of its automatic motor and accompanying devices in use in blowing the organ in St. Paul's chapel at Broadway, Fulton and Vesey streets.

The ordinance for the proposed new plan of street railways, as recommended by Mayor Pridgeon, has been completed at Detroit Overhead wires may be put up outside of the mile circle, but wires must go underground whenever the public welfare requires it and the council orders it. Electricity, rapid transit and any other motive power except steam directly applied, may be used.

The Sprague Electric Equipment company of Chicago is building two extensions for the Lafayette Electric Street Railway company, at Lafayette, Ind. A new overhead switch has recently been invented by J. Marshall Atkinson, one of the engineers of this company, and placed upon the Street Railway company's overhead line. It works to the satisfaction of all concerned, and avoids the serious trouble that existed in the trolley wheel jumping off at switches and turnouts.

"I asked several of the gentlemen in attendance at the street car convention if too much electricity had been injected into the discussion," said Theo. P. Bailey, manager of the railway department of the Thomson-Houston company of Chicago. "They replied in the negative. They were exceedingly interested in the subject. Several of them put in a great part of three days and nights inspecting the Thomson-Houston road at Washington. They tried to find some trouble with the operation of the road, but they could not do it."

The first public pleasure boat to be driven electrically on the River Thames, London, was launched October 9th. It is 65½ feet long, 10-feet beam, and designed to carry 80 passengers at 6 miles an hour, as regulated by the conservancy bylaw. The electrical machinery and storage cells are placed below the deck fore and aft, leaving a clear run the whole length of the boat for passengers. In the middle is a handsomely-fitted cabin with lavatories, dining table, etc. The electrical energy is stored in 200 accumulators, and is converted into motive power by two motors of 7½ horse power each, driving twin three-bladed propellers.

A new method of running accumulator cars, which may yet prove to be the manner in which accumulators will be used in traction, is being worked by Mr. Sandwell, of Victor works, Holloway, says the London *Electrical Engineer*. In this system there is not a separate motor truck, as in the electric locomotive system, but the motor is on the tram car, and the storage cells are carried in a small tender, built to match the car, and hooked on behind. The advantage of this method of carrying the cells is that no alteration is necessary in the structure of the tram cars, and when changing the cells there is no trouble in lifting or pulling the cells out, but the trolley is simply disconnected and shunted

away, while another one, ready charged, is hitched on behind. It will remain to be seen whether this method will prove as practical as the self-contained cars for tramway work, but it is fully evident that in some cases such a system would prove very useful.

The work of grading for the Sprague Electric railway at East Reading, Pa., is nearly completed, and track laying will commence next week. The greatest cut is 7 feet deep and the greatest filling is 30 feet; the grade on one part of this road is as much as 9 feet in 100. The work of erecting poles for the electric wires of the overhead system is progressing rapidly. About one-half the number required are already in position. One-half the rails have been received, and the rest are expected daily. It is expected that the road will be ready for operation in about two weeks. This makes the seventh railway the Sprague company has in operation or in process of construction in the state of Pennsylvania alone.

The west side "L" Road ordinances came up before the committee of the Chicago city council on streets and alleys at the meeting of October 26th. All of the companies with one exception are considering the advisability of employing electric motors. The ordinances were four in number—the West Chicago Rapid Transit company, for Randolph street, Ogden avenue and Lake street; the Hannahs company, for Lake street; the Meigs company, for Lake street, and the Onderdonk, or "alley" company, for the entire west side. It was announced that the West Side Transit company did not have a majority of frontage, and the ordinance was placed on file The "alley" company's ordinance was postponed, and the other ordinances were sent to the law department for examination and revision.

The business men of Newark, O., held an enthusiastic meeting October 23d to further the success of the plans for the construction of an electric road between that city and Granville. Mr Bidwell, representing the Bidwell Electric system, made a statement that the running expenses daily would be $23.50; there would be four passenger cars and one freight He also itemized the probable receipts making it $76 daily, which deducting the expenses, would leave $52.50 income daily. The cost of building the road he figured at a little over $4,900 per mile. Electrician Osyer indorsed the Bidwell electrical system of street railway as a 'perfectly practical business success," Mr. Bidwell's system he said, was the coming one. Enough money was subscribed at the meeting, it is thought, to insure the building of the road.

The South Orange, N. Y., Horse Railroad company is about to conclude arrangements with the Daft Electric Motor company to make a trial of the Daft Electric Railway system on the road between the stables and South Orange, if permission is granted for the erection of poles and wires The poles will be of octagonal yellow pine, painted and set in cement along the curb line on one side of the road, 100 feet apart, and each pole will carry an ornamental wrought iron bracket from which the wires will depend. If the line is in every way satisfactory, permission will be asked to continue it down through the city to the eastern end of his road. Property owners along the line are anxious to have the system adopted, and many of them have freely given permission to erect the poles. When the line is completed through this city it will shorten the time to South Orange from New York. While the authorities of South Orange have been making a strong fight against telegraph poles, it is believed that they will not oppose such a beneficial project as this is.

Great interest was manifested at the Street Railway convention at Washington in the new motors for railway use of the Sprague Electric Railway & Motor company. They are built in two sizes, 7½ and 15 horse power capacity, and are adapted to be applied either to standard cars or to special trucks. They have the regular Sprague mounting, being centered on the axles, and flexibly suspended. They are very compact and powerful, and embody the most recent improvements to meet the exigencies of street car service. The armature pinion meshes into an intermediate with vulcanized fiber teeth to insure quiet running, and the pinion of this shaft into the main gear. All bearings are self-oiling and independently removable. Everything is designed for great strength and ready replacement. The brushes are remarkable for ease of adjustment, and are made on a new principle. The gears are of small diameter and symmetrically placed. A tight fitting cover, moving with the machine and inclosing the gears as well, may be attached. Both the armature bearings, which are self-centering, and the intermediates are fitted with oil and dust guards. The design is not only to make the machine very strong and readily accessible, but to reduce the attendance and care necessary, to a minimum.

The Brush Electric company have shipped to the Nevada mill two dynamos and motors of an improved pattern that will be able to put upon the stamps 80 per cent. of the power generated at the bottom of the shaft, says the *Mining Industry*. There are to be six dynamos, one always to be held in reserve, and six Pelton wheels 40 inches in diameter, to be made of phosphor-bronze, to drive them, each attached to the dynamo shaft direct These wheels will be set up at the Sutro tunnel level of the Chollar mine in a large chamber already prepared to receive them. A column of water brought down the side of Mount Davidson in a wrought iron pipe will be delivered through a proper nozzle upon the surface of the Pelton which stands in the mill, under a perpendicular pressure of about 460 feet. This wheel is 10 feet 10 inches in diameter. After the water leaves the wheel it is piped to the main shaft of the Chollar mine. Down this shaft, and the incline at its bottom, the water is conveyed in two pipes to the electric chamber on the Sutro tunnel level. The water will be put upon the wheels under a perpendicular pressure of 1,630 feet. In no place in the world has water been used on a wheel under such a tremendous head. The water will be delivered upon each wheel through a nozzle somewhat less than ½ an inch in diameter. Each wheel is intended to develop about 125 horse power. This will make a total of some 750 horse power delivered by the six wheels. As this is the first attempt in the history of mechanics to operate water wheels under such an enormous pressure, the result of the experiment will everywhere be anxiously awaited.

THE TELEGRAPH.

The Town of Lake District Telegraph & Electric company has been incorporated at Englewood, Ill.; capital stock, $10,000; incorporators, George R. Waton, F. M. Winters and Charles G. Armstrong.

A motion was recently made before Judge Tuley in Chicago by the attorneys for Senator Farwell, D. B Fisk, and C. M. Henderson, stockholders in the Great Western Telegraph company, to compel John I. Bennett, T. J. Sutherland and George F. Harding to answer questions relative to the defunct Great Western Telegraph company and its connection with Selah Reeve. Sutherland was present in court and said he objected to giving evidence, because Tenney, Bashford & Tenney, attorneys for Senator Farwell and others, wanted to take it in their law office before Notary Davidson, who was their employe. Judge Tuley said he did not think that the office of opposing counsel was the best place to take testimony, and ordered it taken at the office of Notary Davidson.

A Washington dispatch of October 22d says: Chief-Justice Fuller to-day delivered his first opinion in the Supreme court of the United States. The case was that of the Western Union Telegraph company, plaintiff in error, versus the commonwealth of Pennsylvania, brought here on appeal from the Supreme court of the state of Pennsylvania. The commonwealth levied a tax on all telegrams passing over the company's lines within the state, this tax being imposed regardless of the fact that much of the business was not confined wholly to the state, but was to points in other States. The Supreme court to-day held through Chief Justice Fuller that the state was not entitled to collect a tax except for messages between points within the borders of the state, and accordingly reversed the judgment of the state court with costs, and remanded the case to the lower court for further proceedings.

A New York dispatch says: The second trial of the suit of the Commercial Telegram company to obtain an injunction restraining the New York Stock exchange from removing the stock quotation tickers of the company from the floor of the exchange, was begun to day before Judge Andrews in special term of the Supreme court The company was represented by Col. Robert G Ingersoll and James E. Chandler, and the Stock exchange by James C. Carter and L. Cass Ledyard. Luther E. Shinn was the only witness examined. He negotiated between the company and the exchange for the admission of the company to the floor of the exchange. It is claimed for the Commercial Telegram company that by virtue of an agreement made in October, 1883, it obtained the same rights granted to the Gold & Stock Telegraph company to collect and send out the quotations from the exchange on condition of payment of $18,000 per year, and that these privileges granted were perpetual.

Willis J. Cook, the noted telegraph operator, and familiarly known as "Bif," died at the home of his parents in Sandusky, O., October 23d, aged 37, from blood-poisoning resulting from malarial fever contracted at Aspinwall, where he was chief operator in the service of the Panama railway. He was known far and wide as one of the greatest experts of the craft, and several years ago was in the service of the Associated Press at Washington, on the New York and Washington circuit. His remarkable feats of telegraphy there made him famous among operators throughout the country. He was not famous, says a Chicago paper, in the sense of having sent more words in a short time than some other man, or for having done some unaccountable feat. He was famous for his common sense and steady application. He would sit at a table all day and "send," and when he came to a hiatus or a bad break of the writer his brain was so quick that he would supply the omission or make the correction almost as quickly as his eye caught it. In receiving he displayed the same rapid intelligence and would correct as he wrote, so that when his copy was laid on the desk of the average telegraph editor it was ready for the printer. He was not only a rapid receiver but his penmanship was marvelously plain and distinct, and averaged just so many words to a line, so many lines to a page, day after day, night after night.

THE TELEPHONE.

Telephones are a great convenience, and yet people are all the time talking against them.—*Yonkers Statesman.*

The telephone company intends to make a number of improvements in its lines in Council Bluffs, Ia. A line will be built to Glenwood.

It is reported from New Haven that the Southern New England Telephone company, by means of its long distance connections, expects to cover Connecticut perfectly by telephone and get the election returns in as early as possible from all the towns.

At a meeting of the city council at Toronto, October 19th, the municipal committee presented a report recommending that the telephone, telegraph and electric light wires be put underground. It was suggested that the government should own and control the underground franchises.

In Philadelphia the Bell Telephone company is building a conduit three feet wide through the main streets and avenues of the city, which will contain fifty 3 inch iron pipes and fifty wooden tubes laid in cement with a capacity of 100 wires each, a total of 10,000 wires. Connection will be made with each block by a branch running from a main conduit to the middle of the block, and in nearly all the blocks there are small streets and alleys in which the distributing pole can be conveniently erected, leaving the main streets entirely free from wires. A Pittsburgh paper quotes this paragraph, and adds: This is a coming question in Pittsburgh.

PERSONAL PARAGRAPHS.

C. D. Crandall, secretary of the Missouri & Kansas Bell Telephone company of Kansas City, Mo., was in Chicago for several days this week.

W R. Kimball of the Royal Electric company of Toronto delivered a lecture on frictional electricity before the Y. M. C A. of that city, October 18th. The lecture was illustrated by a number of interesting experiments.

Walter K. Freeman, lately with the Fort Wayne Jenney Electric Light company, is now the electrician and general manager of the National Electric Manufacturing company, a new company just organized at Eau Claire, Wis. The other officers are: H. H. Hayden, president; Fitch Gilbert, vice-president; R. E. Rust, secretary; E. B. Putnam, treasurer; C. Kammeyer, superintendent of construction. The new company is strongly backed, and has our best wishes for its success.

W. S. Andrews, who was connected with the Marr Construction company, and who has just completed the construction of the Edison Central station in Chicago, is now associated with Leonard & Izard of Chicago. Mr. Andrews is an electrician of the soundest qualifications, and will have in his new field of work more scope for the display of his ability than in the department in which he has been engaged. The association will prove advantageous alike to Mr. Andrews and Leonard & Izard.

Miscellaneous Notes.

The Cutting Electric Alarm company, of East St. Louis, has been incorporated. Capital stock, $8,000: incorporators, W. H. Cutting, B C. Graham and B. Gratz

The new fire alarm telegraph wires of Mobile, Ala., are strung and ready to be attached to the new boxes, which will hereafter be placed on poles, and not on the walls of buildings. A representative of the Gamewell company is expected daily to put up boxes.

Charles Toppan of Salem, chemist of the Canton, Mass., Manufacturing company, has for some time been experimenting with a new compound for preserving the life of storage batteries, and has used an old, wornout battery a month with no perceptible decrease of power. Among other experiments made by him were some with telephone batteries, into which he injected a zinc compound.

Science is constantly enhancing man's comfort. Says an exchange: 'A Brooklyn electrician has discovered a way to secure peaceful nights. He has attached a wire to the back fence, and when the gallant Thomas cats alight and begin to sing their tuneful ballads he turns on the battery and knocks the serenaders ten feet high. The cats are not injured but they are so surprised that they are inclined to let the fence alone thereafter.'

The report of the special lighting committee of the board of aldermen of Detroit, Mich., reference to which has been made in the Detroit correspondence of this journal, has been printed in pamphlet form The clerk of the committee, Fred H. Whipple, who was employed to gather and compile all the necessary information upon the various divisions of the subject, worked indefatigably, and the result is a very exhaustive presentation of the subject.

A dispatch dated October 24th, from Harrisburg, Pa., says an apparatus has been invented by Daniel Drawbaugh of Eberley's mills, to be used for signaling vessels in mid-ocean, and which can be used on vessels to signal one another. Mr. Drawbaugh, who has achieved fame by his claim that he was the inventor of the telephone, has worked long and patiently in the pursuit of this new discovery, and experts who have examined it assert that it is a valuable invention, and one which will create a revolution in naval affairs. A public exhibition of the apparatus will be made in the Susquehanna River in a few days, on which occasion marine officers and experts will be present.

Messrs. Gony and Rigollet have devised a small battery of peculiar construction that may, according to the *British Journal of Photography*, be used as an actinometer. It is made by heating a clean plate of copper over a Bunsen burner till a layer of cuprous oxide forms; this plate, with one of unaltered copper, forms the battery. A galvanometer is introduced into the circuit, and the battery then exposed. The effect is instantaneous, and disappears when the light is cut off. Diffused daylight produces an alteration of several hundredths of a volt, direct sunlight an alteration of at least a tenth of a volt. It is stated that with a Thomson galvanometer it is possible to recognize the effect of a candle flame at a distance of several yards.

Business Mention.

The factory of the Sprague Electric Railway & Motor company of New York is very busy filling the contracts which it has in hand.

The Edison Electric Light company has issued a new pamphlet devoted to the Edison system of incandescent lighting and electric motive power from central stations. The pamphlet is liberally illustrated, and to those considering the organization of electric light companies, is interesting and valuable

The Sprague Electric Railway & Motor company of New York recently closed the twenty-ninth contract for the equipment of street railroads on the Sprague system. When it is remembered that this is simply the record of the last eight months, and that on the 1st of February last the Sprague company had not a single road in operation, it is, indeed, a wonderful showing.

Some time ago the WESTERN ELECTRICIAN referred to a series of tables, compiled by H. D. Stanley for the Bridgeport Brass company, showing the stress in pounds on a span of that company's hard-drawn bare copper wire for any given dip from 2 to 30 inches when in a state of absolute rest, and for spans of varying length. A copy of these tables, handsomely bound in red morocco, has been re-

ceived at this office, and will form a valuable book for reference Calculations are made for Brown and Sharpe, Birmingham or English, and the new British standard gauges. The book also contains a table showing the difference between gauges, and a memorandum of iron, steel and copper wire.

The American Leather Link Belt company, 46 and 48 Ferry street, New York, report recent sales of their belting to the following concerns for use on dynamos, Standard Light & Power company, Montpelier, Vt.; Travers Bros., 556 West Fifty-second street, New York; Edison Electric Illuminating company, Boston, Mass.; Burlington Gas Light company, Burlington, Vt.

The Waterhouse Electric & Manufacturing company of Hartford, Conn., was awarded a gold medal at the Cincinnati Centennial exposition and two silver medals, covering the arc light plant at the exposition. The judges spoke in the highest terms of the Waterhouse system of electric lighting. This is the second gold medal awarded to the Waterhouse company, the first having been received from the Mechanics' fair in Boston, in December last.

The Buffalo, N. Y. Electric Light & Power company, operating 2,500 lights on the Westinghouse alternating system, has recently been testing the Westinghouse meter. As a result of this test the Buffalo company find they are enabled to compete with gas on an equal basis. A contract has just been closed with J. H. Gates of the Westinghouse Electric company for two 1,500 light dynamos with the necessary meters. This company has also purchased three 150 horsepower Westinghouse compound engines.

James W. Queen & Co. of 924 Chestnut street, Philadelphia, have made an enviable reputation as manufacturers of and dealers in instruments of precision. They import many instruments of the best foreign make Though the salesroom is on the ground flour, the principal electrical departments are on the second floor, in charge of Electrician Heinrich. The designing room is here, and new and interesting developments are the rule The following universities have lately been supplied with a full equipment of standard electrical test instruments by this concern: University of South Carolina, University of Nebraska, and Vanderbilt University

Henry H. Pryor, president of the Woodbury Engine company of Rochester, N. Y., writes to an old time friend in Chicago a personal letter, and the liberty is taken of making a few pertinent extracts which fortify the position always held by the Woodbury Engine company, that the best work is in the end the cheapest to the purchaser:

"You will remember that at one time we had quite a trade in Colorado. Low priced work, sometimes called 'cheap work'—offered by other manufacturers—caused us to practically lose our Colorado trade. The results that this 'cheap' work gave evidently have not been satisfactory, as we have sold two of our 55 horse power, automatic cut-off engines, two 65 horse power boilers and one 25 horse power boiler to go there. Each of the three boilers went to different parties, as did also the two engines; that is, a 55 horse power engine and a 65 horse power boiler went to one party, and a 55 horse power engine and a 65 horse power boiler to another party, and the 25 horse power boiler to a third party, and in each case the purchasing parties assured us that they could purchase from others for less money, but that the satisfaction the work we had furnished for that section of the country gave as compared with work that had been supplied by others, had led them to bestow their patronage on us. One of the outfits went to Denver, Col., and the other two to Longmont, Colorado. This looks as though the saying were true, that 'blood will tell in the long run.' We have completed three 48 horse power boilers for the block that Henry Bartholomay is building in this city; one 48 horse power boiler for Oliver Allen & Son's woolen mills, at Mumford, N. Y., to take the place of a smaller boiler that we made for them eighteen years ago; one 48 horse power boiler for the Elwood Memorial building, in this city, to take the place of a boiler that we placed in it when that building was erected; two 25 horse power boilers for the New National hotel in this city, to take the place of two boilers of the same size, of the so-called 'cheap' sort that were put in there about five years ago, and which have already proved unfit for use; one 75 horse power boiler for the Palace Steam Laundry company of this city; two 32 horse power boilers for public school No. 18, in this city; one 84 horse power boiler for George W. Cronch, jr., of this city; one 25 horse power engine and boiler for Whitmore, Rauber & Vicinus of this city; one 60 horse power automatic cut-off engine, with boiler, for Sage & Potter, Churchville, N. Y., and one 14 horse power boiler for M. W. Tilden, Albion, N. Y."

A splendid showing is that made by the Westinghouse Electric company in the following list, which comprises central stations only, and not isolated plants, of its alternating current system. The total number of stations is 119. The list gives first, the location of each plant, the number of 16 candle power lamps in use, and the name of the operating company or individual:

Albany, N. Y., 1,300, Albany Electric Illuminating Co.; Allegheny City, Pa, 7,600, Allegheny County Light Co; Altoona, Pa., 650, Mountain City Electric Light Co.; Aspen, Col., 650, Roaring Fork Electric Light & Power Co.; Aurora, Ill, 650, Aurora Electric Light & Power Co.; Austin, Tex., 5,200, Austin Water, Light & Power Co.; Baltimore, Md, 5,000, The Brush Electric Co. of Baltimore City, Md.; Bath, Me., 1,300, Bath Electric Light & Power Co; Beaver Dam, Wis., 1,300, Beaver Dam Electric Light Co; Bennington, Vt., 650, Bennington Electric Light & Power Co.; Black Hawk, Col, 400, Stearns, Roger & Co.; Braddock, Pa, 650, Citizens Electric Light Co.; Buffalo, N. Y., 3,250, Buffalo Electric Light & Power Co; Buffalo, W. T, 650, Geo T. Beck; Carbondale, Pa, 1,300, Electric Light, Heat & Power Co.; Cedar Rapids, Ia., 1,950, Cedar Rapids Electric Light & Power Co.; Charleston, W. Va, 650 Kanawha Electric Light Co.; Chattanooga, Tenn, 1,950, Chattanooga Electric Light Co; Chicago, Ill., 1,500, Consumers Electric Light Co.; Colorado Springs, Col, 1 950, El Paso Electric Co; Columbus, Ohio, 2,600, Columbus Gas Light & Coke Co.; Conshohocken, Pa, 1,300 Conshohocken Electric Light & Power Co.; Cornwall, Ont; 1,300, Stormont Electric Light & Power Co,; Denver, Col., 7,800, Denver Light, Heat & Power Co.; Downingtown, Pa, 400, H. D. McFarlan; Duluth, Minn, 1,300, Duluth Electric Light & Power Co, Easton, Md., 650, Easton Electric Light Co.; Eau Claire, Wis., 1,300, Frank McDonough; Elizabeth, N. J, 650, Elizabeth Electric Light, Heat & Power Co.; Englewood, Ill, 750, Englewood Electric Light Co.; Evansville, Ind, 1,300, Evansville Gas & Electric Light Co; Flint, Mich, 650, People's Electric Light & Power Co.; Fort Edward, N Y., 650, Ft. Edward Electric Light & Power Co., limited; Fort Worth, Tex., 1,950, Ft. Worth Electric Light Co.; Gainesville, Tex., 650, Gainesville Gas Co; Galveston, Tex., 1 300, Brush Electric Light & Power Co,; Greensburg, Pa., 600, The People's Electric Light Co.; Hagerstown, Md., 1,300, Hagerstown Electric Co.; Halifax, N S, 650, Chandler Electric Light Co,, limited; Hartford, Conn,, 3,250, Hartford Light & Power Co; Hillsdale, Mich, 650, Hillsdale Electric Light Co.; Hoboken, N. J., 1,300 Hudson Electric Light Co,; Hoosick Falls, N. Y., 1,300, Hoosick Falls Electric Light Co.; Hot Springs, Ark., 650, Hot Springs Electric Light Co.; Houston, Tex., 650, The Houston Electric Light & Power Co. of 1887; Joliet, Ill, 650, Joliet Electric Light Co.; Junction City, Kan., 650, Junction City Electric Light Co; Kingston, Ont., 650, Kingston Electric Light Co., limited; Lincoln, Neb., 1,950, Lincoln Electric Light Co.; Little Rock, Ark,, 650, Little Rock Electric Light Co; Littleton, N. H., 650, Littleton Water & Electric Light Co.; Mansfield, Ohio, 650, Mansfield Electric Street Railway Co.; Maqnoketa, Iowa, 650, Barnes Brothers; Marshall, Tex., 650, Marshall Electric Light & Power Co; Mendota, Ill, 650, Mendota Electric Light Co; Minneapolis, Minn., 6,500, Minneapolis Electric Light Co; Montgomery, Ala, 1,300, Brush Electric Light & Power Co; Morristown, N. J, 1,300, Morristown Electric Light, Heat & Power Co.; Nashville, Tenn., 1,300, Nashville Light & Power Co.; Newark, Ohio, 650, Newark Electric Light & Power Co; New Bedford, Mass, 2,600, New Bedford Gas Light Co; New London, Conn., 1,300, New London Electric Light Co.; New Orleans, La., 6,500, Louisiana Electric Light & Power Co.; Norwich, N. Y., 650, Norwich Electric Light & Power Co.; Oakland, Cal., 1,300, Oakland Gaslight & Heat Co.; Olean, N. Y., 650, Olean Electric Light & Power Co.; Oneonta, N. Y., 650, Oneonta Electric Light & Power Co.; Ouray, Col. 650, Ouray Electric Light & Power Co.; Paducah, Ky., 400, Paducah Gaslight Co.; Palmer, Mass., 650, Palmer Electric Co.; Parkersburg, W. Va., 1,950, Parkersburg Electric Light & Power Co.; Passaic, N. J., 650, Passaic Electric Light, Heat & Power Co.; Peekskill, N. Y., 1,300, Peekskill Electric Light & Power Co.; Philadelphia, Pa., 1,950, Keystone Light & Power Co.; Pine Bluff, Ark., 1,300, Pine Bluff Water & Electric Co.; Pittsfield, Mass., 2,600, The Pittsfield Illuminating Co.; Pittsburgh, Pa, 15,600, Allegheny County Light Co.; Pittsburgh (East End), 5,200, East End Electric Light Co.; Pittston, Pa., 1,300, Citizens' Electric Illuminating Co; Plainfield, N J, 3,900, The Plainfield Electric Light Co.; Port Huron, Mich., 650, Excelsior Electric Co. of Port Huron; Port Jervis, N. Y., 650, The Deer Park Electric Light Co.; Portland, Me., 650, Consolidated Electric Light Co. Pueblo, Col, 1,300, The Pueblo Light, Heat & Power Co.; Red Cloud, Neb., 650, Red Cloud Electric Light Co.; Richfield Springs, N. Y., 650, Richfield Springs Electric Light & Power Co.; Richmond, Va., 6,950, The Virginia Electric Light & Power Co.; Salem, O., 1,300, Salem Electric Light & Power Co.; Salina, Kan., 650, Salina Gas & Electric Light Co.; San Antonio, Tex., 650, Electric Light & Power Co.; San Bernardino, Cal., 1,300, The Electric Light & Power Co of San Bernardino; San Diego, Cal., 1,300, Geo D. Copeland; Sandusky, O., 1,300, Sandusky Electric Light, Fuel Gas & Supply Co.; Savannah, Ga., 2,600, Brush Electric Light & Power Co.; Schenectady, N. Y., 2,600, Westinghouse Illuminating Co.; Seward, Neb., 650, Seward Electric Light & Power Co.; Sheffield, Ala., 650, Sheffield Electric Light Works; Shreveport, La., 650, The Shreveport Incandescent Electric Light Co.; Sing Sing, N. Y., 1,300, Sing Sing Electric Light Co; Sioux City, Ia., 650, Sioux City Electric Co.; Springfield, Mass., 1,950, United Electric Light Co.; Springfield, O., 1,950, Champion Electric Light Co.; Stapleton, N. Y., 4,550, Richmond Light, Heat & Power Co., Limited; Steubenville, O., 1,950, Electric Light & Power Co; Stillwater, Minn., 650, Stillwater Gas & Electric Light Co.; St Cloud, Minn., 650, The St. Cloud Gas & Electric Co.; St. Louis, Mo., 2,600, The Metropolitan Electric Co.; St. Paul, Mino., 2,600, St. Paul Gas Light Co.; Tampa, Fla., 650, Tampa Electric Light & Power Co.; Torrington, Conn., 1,300, The Torrington Electric Light Co.; Trenton, N. J, 3,250, People's Electric Light Co.: Troy, N. Y., 1,300, Troy Electric Light Co.; Tyler, Tex., 650, Tyler Electric Light Co.; Tyrone, Pa., 1 300, Home Electric Light & Steam Heating Co.; Weyers, Cave, Va., 650, The Grottoes of the Shenandoah; Wheeling, W. Va., 1,950, The Wheeling Electrical Co.; York, Pa., 650, York Electric Co.; Providence, R. I., 2,000, Narragansett Electric Light Co.; Beaver Falls, Pa., 650, W. H. Hartman.

Electrical Patents.

Issued October 23, 1888.

391,437. Electrical Potential Differentiator. Elihu Thomson, Lynn, Mass.

The invention consists in the combination, with two or more coils of definite capacity, size or relation placed in the same inductive relation to one another, as on the same core, of suitable means for connecting one or more of the coils into a primary or impressing circuit, and suitable means for connecting one or more—the same or different coils—into a secondary or impressed circuit. The 3d claim reads: "In an electric converter, a coil divided into a number of equal sections, one or more of which sections are further divided into sub-sections, and means for including any one or more of such sections and sub-sections in an external electric circuit, primary or secondary."

391,446. Clock Synchronizer. Arthur G. Wiseman, Webster Groves, Mo.

391,447. Electric Railway. Parvin Wright, Denver, Col.

Claim 2 is as follows: "The combination of the conduit, the main line, the main line contacts, the separator, the circuit-changing devices protected by the conduit, and mechanical connections between the main line contacts and circuit-changing devices."

391,468. Automatic Circuit Changer for Secondary Batteries. William W. Griscom, Haverford College, Pa.

The invention comprises an electro magnet located in the working circuit, wound, arranged and adjusted to respond to a predetermined strength of current; its object is to prevent too rapid a discharge in the working circuit of a secondary battery. The 1st claim is: "The combination of a secondary battery, a working circuit therefor, a switch or circuit-changer for making and breaking said circuit, and an electro-magnet having its coils included in said circuit controlled by a predetermined strength of current to operate said switch or circuit-changer."

391,477. Arc Lamp. Hosea W. Libbey, Boston, Mass.

The spiral carbons are fed in opposite directions, so as to always bring their points of contact in the same place. The object is to produce a feed for spiral carbons for electric lighting in which two spiral carbons are arranged one within the other.

391,505. Galvanic Battery. Horatio J. Brewer, New York, N. Y.

The invention consists, essentially, in an arrangement by which the zinc and carbon can be placed in advantageous relation to each other, and an arrangement by which a large amount of carbon surface can be obtained, and by which likewise bodies wholly or partly of carbon can be readily attached to or removed from a central conducting carbon.

391,512. Electric Switch. William B. Cleveland, Cleveland, O.

Broadly speaking, the invention consists in combining together a primary actuating device, a movable contact bar, and a spring connected, respectively with said two parts, said primary actuating device having a range of movement wherein the line of said two spring-connected points may pass, respectively, to opposite sides of the dead-center line of the spring movement, the spring being under compression or tension between the primary actuating device and the contact bar, thereby throwing the latter in a quick movement either to open or closed position, accordingly as the line of spring power may be shifted to one side or the other of said dead center line.

391,517. Electro Cable Joint. Joseph E. Cuff, Denver, Col.

391,547. Electrical Continuity Vibrator. George F. Milliken, Boston, Mass.

391,568. Railway Train Indicator. Benjamin E. Waters, Brockton, Mass.

391,587. Conduit for Electric Wires. Madison Dallas, New Orleans, La.

391,590. Electric Motor. John Doyle, Hoboken, N. J.

391,592. Electric Measuring Instrument. Arthur H. Eddy, Hartford, Conn.

The invention is based upon the mutual attraction set up between the convolutions of a coil of wire by the passage of a current through the coil, so that a coil whose convolutions are free to move with the passage of current contracts in axial length, and the movement thus produced can be communicated to an index adapted to travel over a scale and the effect indicated directly in amperes or volts.

391,593. Automatic Commutator for Alternating Electric Currents. Arthur H. Eddy, Hartford, Conn.

The invention relates to a vibrating motor operated by the alternating current and actuating switching devices adapted to switch all the alternations into a succession of impulses in one direction in the motor circuit.

391,594. Arc Extinguisher for Electric Switches or Cut-Outs. Arthur H. Eddy, Hartford, Conn.

The invention consists in a switch or cut-out, so constructed that immediately following the act of rupture of the circuit, a fan blade of non-conducting material will be set in rapid motion across the path which the arc would take, whereby if a tendency to arc is present it will be literally blown out.

391,595. System of Electric Lighting. Thomas A Edison, Menlo Park, N. J.

391,596. Incandescent Electric Lamp. Thomas A. Edison, Menlo Park, N. J.

In the manufacture of incandescing lamps, the arcing of the lamps on the pumps occurs frequently, and since this occurs when such lamps are nearly completed, the loss from this source is considerable. The object of the invention is to prevent this action. The first claim is: "The combination of the inclosing globe, the filament, the leading-in wires, and an enlarged terminal for one end of the filament."

391,605. Cable Hanger. Edward J. Hall, Buffalo, N. Y.

391,720. Electric Plaster. Harry P Pratt, Chicago, Ill.

391,761. Electric Arc Lamp. Samuel E. Nutting, Chicago, Ill.

The invention comprises an automatic brake or retarder, whose effect will maintain a constant relation to the electric current, so as to vary as it varies.

391,762. Telephone Exchange System. Charles E. Scribner, Chicago, Ill.

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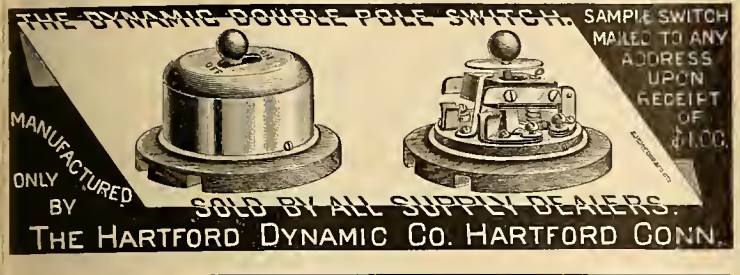

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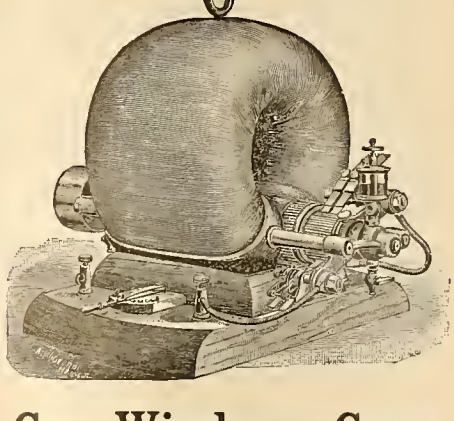

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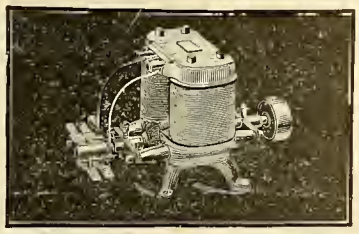

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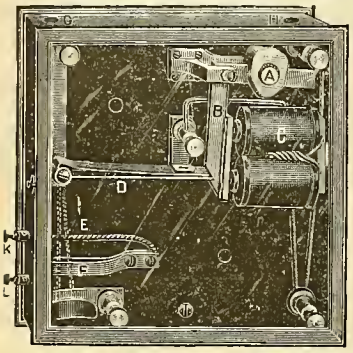

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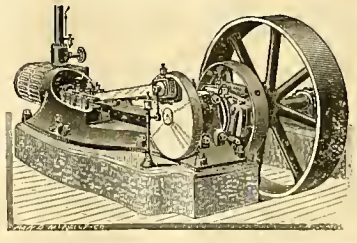

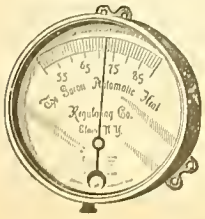

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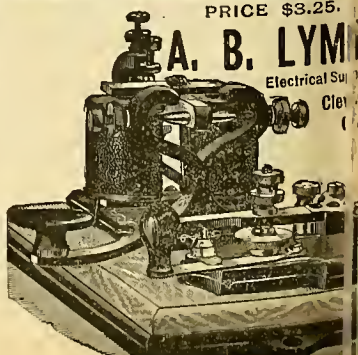

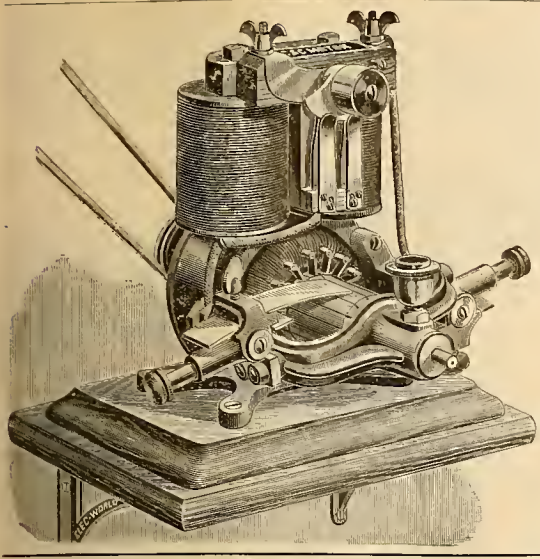

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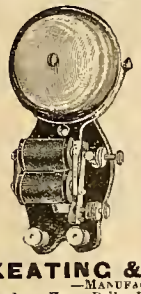

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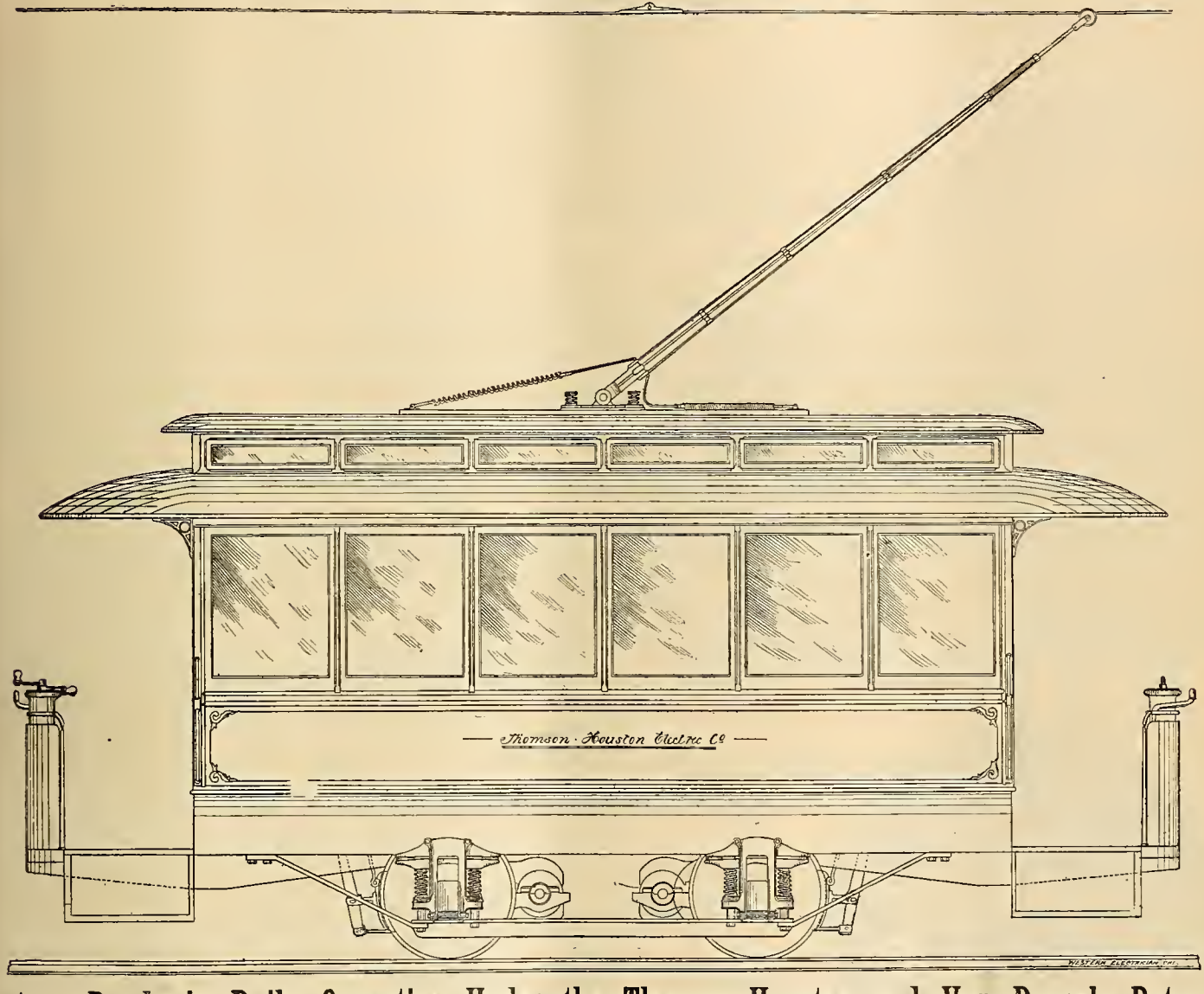

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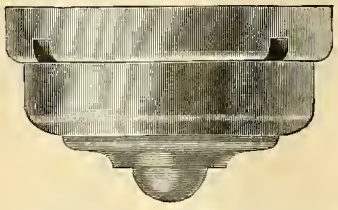

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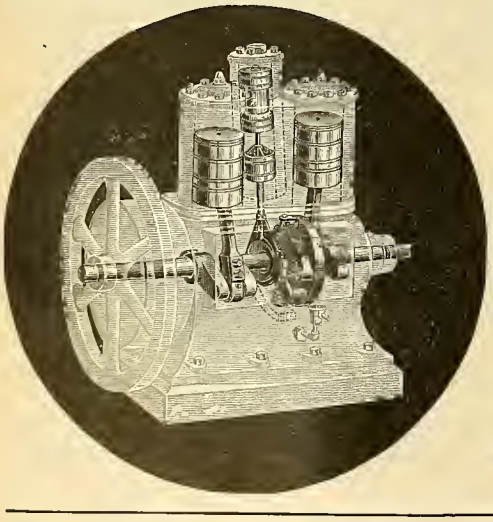

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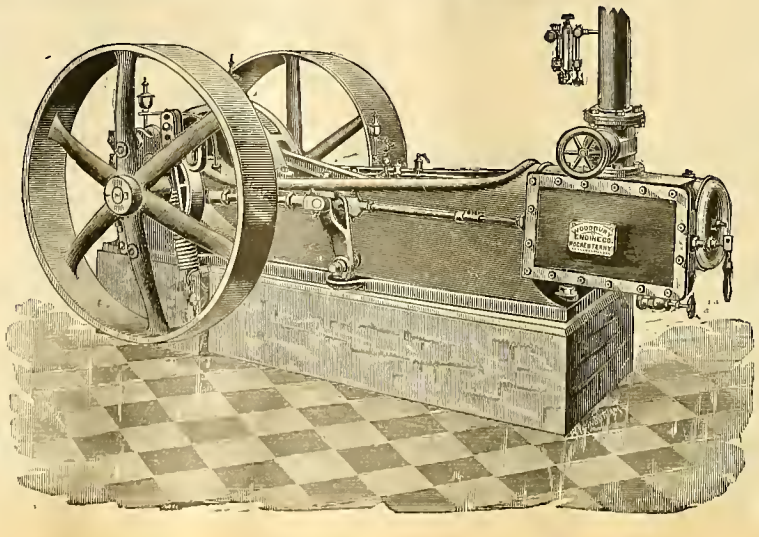

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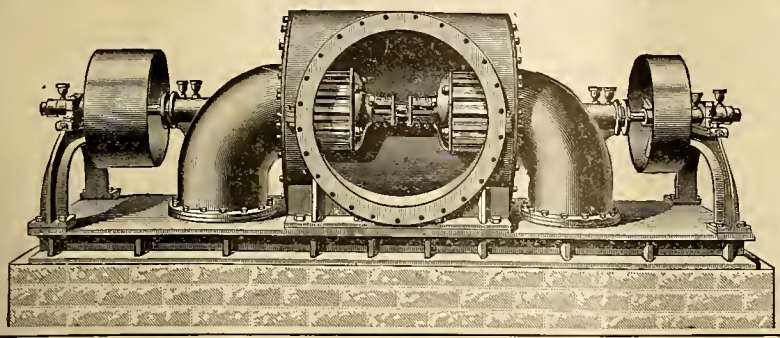

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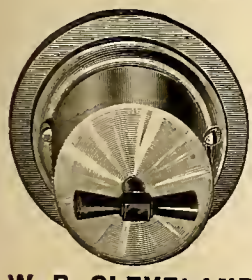

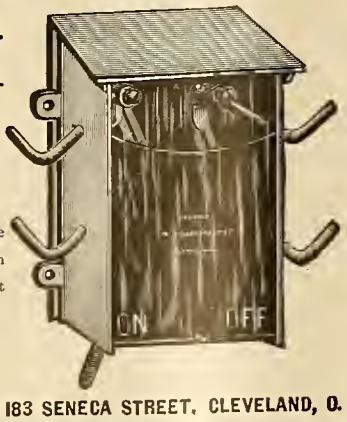

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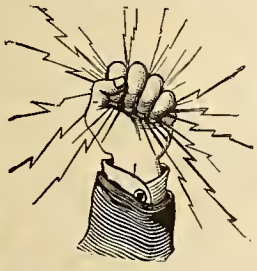

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Cut full size.
Patented May 1, 1888.

TO THE ELECTRICAL TRADE.

Gentlemen: We respectfully announce the production of **a New Automatic Gas-lighter and Extinguisher**, which we purpose placing upon the market. Always on the alert for practical improvements in this line, we are pleased to offer you this new device, **a radical departure** from the old style Automatic Gas-burners. It is considered, by competent judges, **a very important advance in the art** of lighting gas by electricity. **We have christened** the new burner

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Third. It operates under a single impulse, **is extremely simple in construction,** does not easily get out of order, and requires only minimum battery power.

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Fifth. **What does it mean?**—Less cost and more profit to the electrical fitter; **besides the saving in wire** and push-buttons or keys, **the trade price of the burner itself is one dollar less** than the "single magnet" burner.

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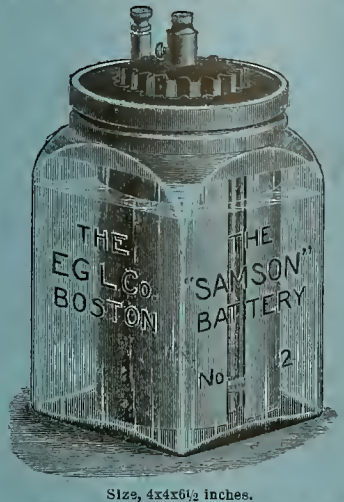

Size, 4x4x6½ inches.

In France, where the Leclanché Battery originated and flourished, **the "Samson" now takes the lead.** America, too, demands the best; and, as she took the Leclanché and adopted it so largely, so now and for the same reason she is receiving the "Samson," the latest improvement and highest advance in open-circuit batteries, into her high favor. Its rapid introduction and sale in the United States **mark a new era for all electricians** and fitters who have been annoyed by the uncertainty and burdened with the consequent high cost of battery power.

What merit has the "Samson" Battery to account for its sustained popularity abroad, and its growing favor here? Its **remarkable endurance** and **long life** without loss of power, render it **especially valuable for transmitter service,** electric gas-lighting and bell work. There are no prisms or porous cups to wear out. The **"Samson" Corrugated Carbon Porous Cup is practically inexhaustible.** The **Cylindrical Zinc** weighs 3 1 2 times **more** and has a surface 15 times **greater** than the Leclanché zinc; it therefore **lasts much longer,** and, together with the very porous and large surfaced carbon, reduces the internal resistance of the battery to almost nothing, thus **greatly increasing its available current strength.**

A TRIAL ALWAYS BRINGS CONVICTION.

We observe that practical Electricians who have given the "Samson" a trial are enthusiastic about it, and in a great number of cases **adopt it exclusively.** No higher praise could be accorded it than the **continued and constantly increasing orders** received from those who early ventured, at first cautiously though it was, to try this latest open-circuit cell. **Thanks to the courage of a few,** it is getting to be the conservative thing among many to use the "Samson" Battery

WELL, WHY NOT?

It is simply a matter of **dollars and cents.** If the "Disque" Leclanché costs 50 cents and the "Samson" 75 cents, but lasts **three times as long,** you don't need higher mathematics to determine which it will pay you best to use! Experience here and abroad, as well as scientific opinion and common sense, teach that the "Samson" Battery will on an average outwear three cells of the best "Disque" Leclanché! At any rate, **it will cost you nothing to verify these statements for yourself.**

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The magnets may be wound to any desired resistance to suit the requirements of any circuit. The large sized gongs are fitted to order for use on reversal circuits. Continuous ringing attachments are furnished with the gongs, when so ordered.

The instrument, as will be seen, is equally adapted for open or closed circuit. It is weather proof, provided with lightning arrester, and mounted in handsomely finished black walnut or ash case, with plate glass front.

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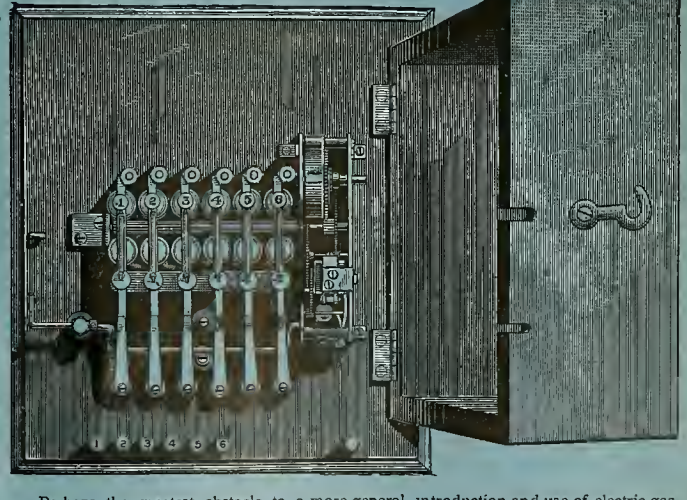

Perhaps the greatest obstacle to a more general introduction and use of electric gas-lighting apparatus has arisen from "grounding" or accidental closing of circuits, and consequent running down or depletion of the battery. Numerous instruments have been devised for overcoming these difficulties, but they have been either inadequate or so complicated as to be more liable to get out of order than the apparatus they were designed to protect. This Company, after long and expensive experiments, has produced and perfected a Sectional Cut-out wholly automatic, yet simple and reliable. It is arranged to leave all circuits in the several sections of the house not in fault fully operative, and to indicate at a glance *which* circuit is deranged.

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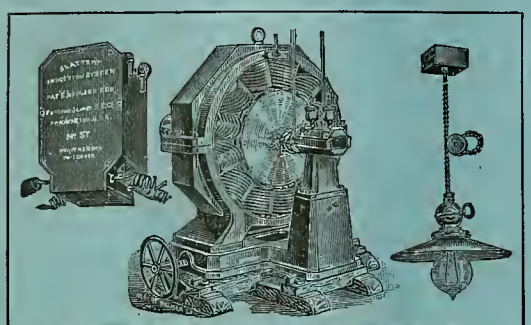

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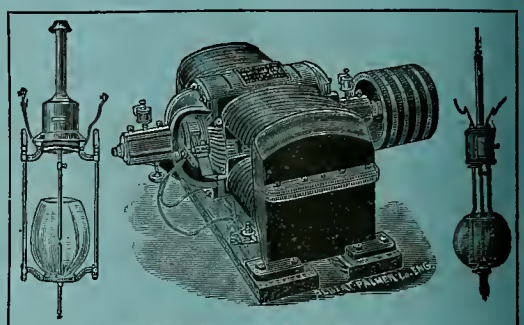

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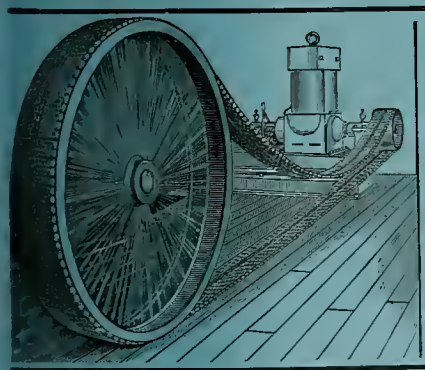

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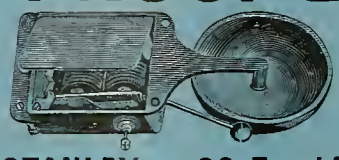
Superior to  All Others.

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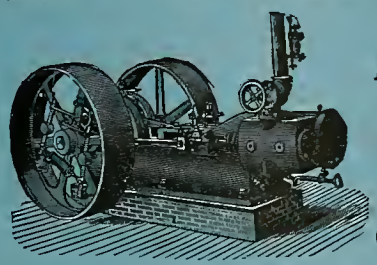

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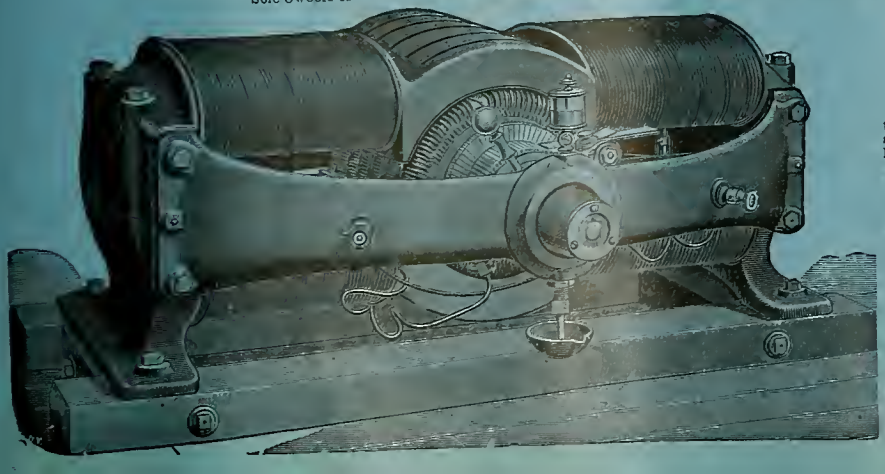

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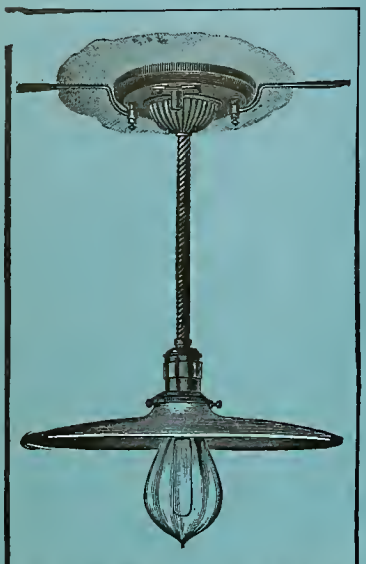

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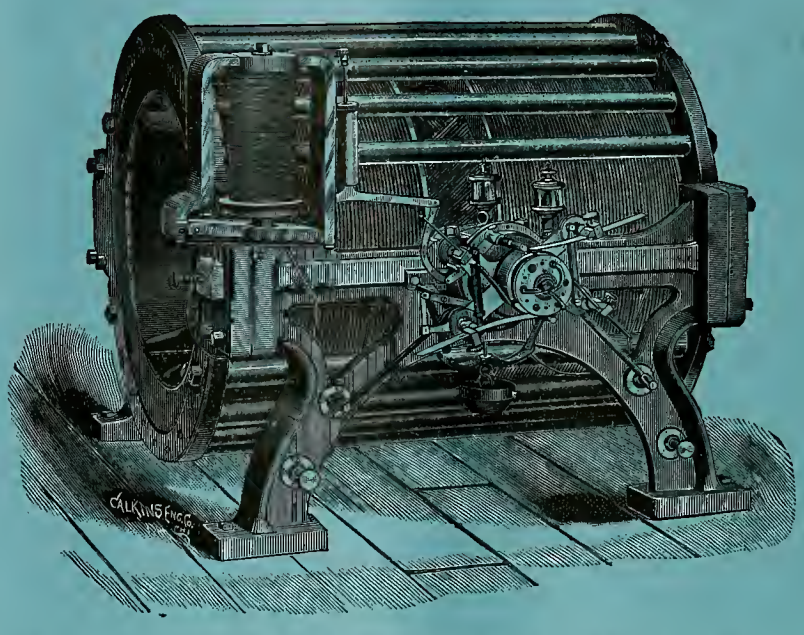

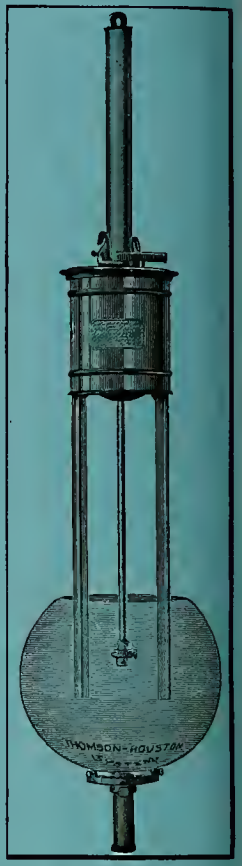

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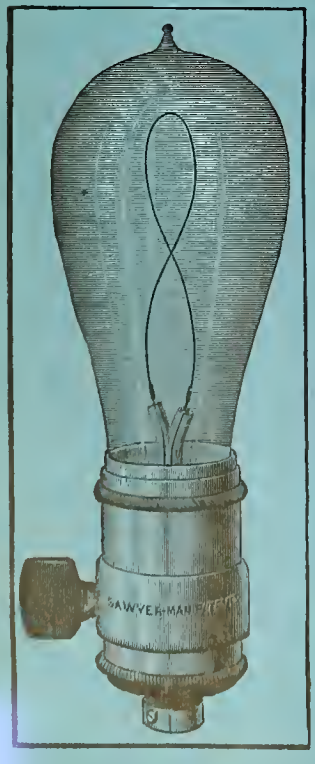

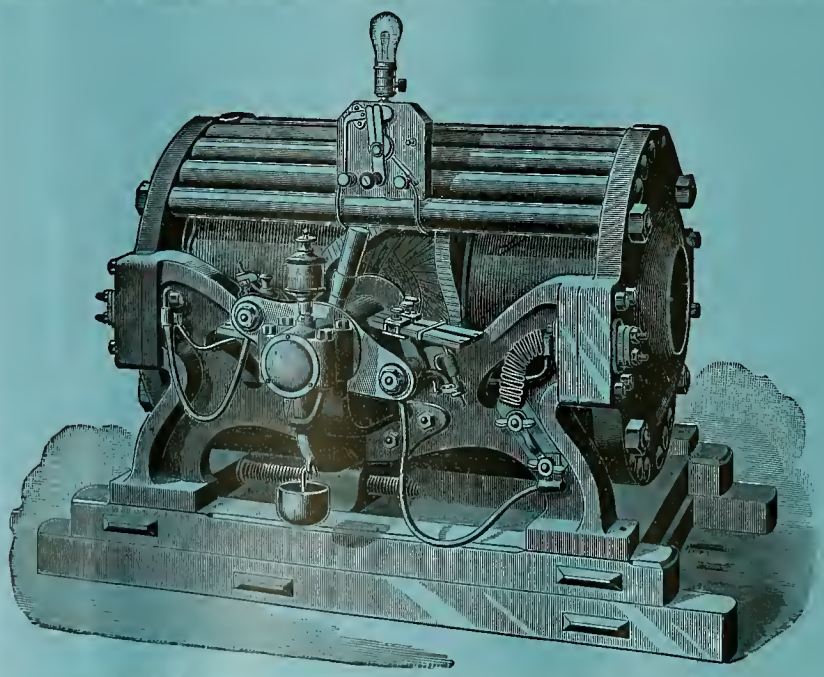

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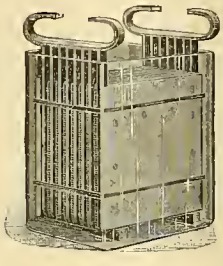

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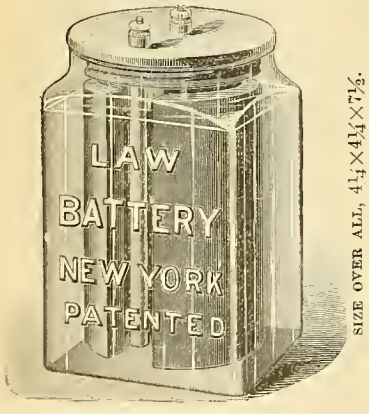

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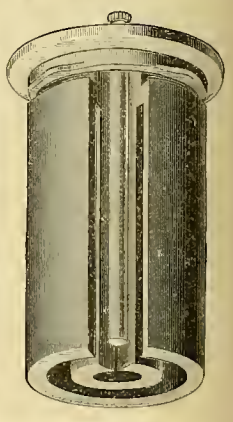

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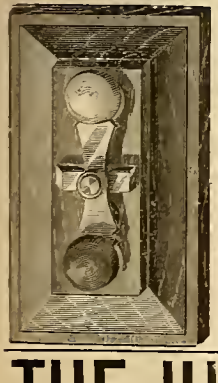

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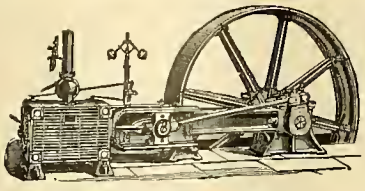

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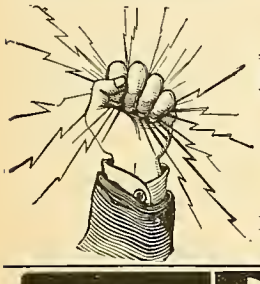

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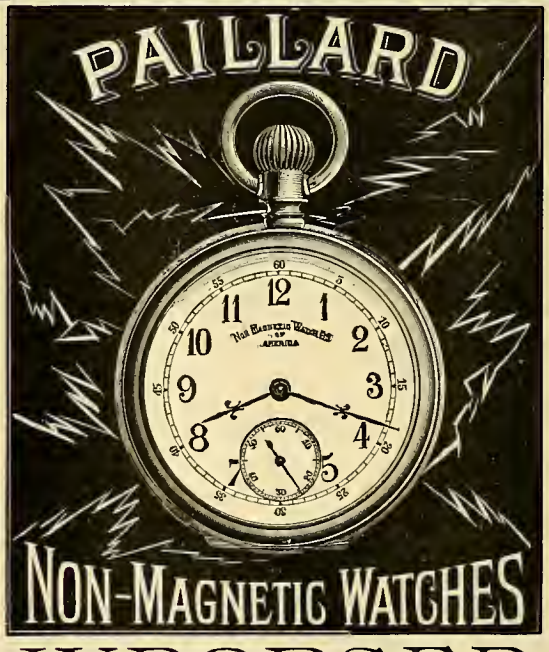

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Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, NOVEMBER 10, 1888. No. 19.

A Model Brush Plant.

The new chamber of commerce in Cincinnati, O., will be, when completed, the finest building in that city, and one of the finest public buildings in the west. The Brush Electric company is installing the electric light plant, and the installation is in keeping with the general character of construction, that is, the best. There will be three 450 light dynamos run by two Buckeye engines, one of 75 and the other of 92 horse power. The chandelier in the main hall will have sixty-four 32 candle power light lamps in it, while the total number of lights will be 260, thus affording ample illumination, notwithstanding the vastness of the room.

The circuits are very justly the pride of the installing electrician, Arthur Thurlby. They are of okonite and of ample size for the current they have to carry. All the mains are carried along the ceiling of the cellar in which the dynamos are stationed, and thence to a recess in a main wall in which they are carried to the upper floors. This recess is covered with an oak panel which can be readily removed in case there is any necessity for getting at the main circuits. The branch circuits are carried to the various rooms of the upper floors along the ceiling, and are buried in the plaster. There are no staples used to hold the wires in place until the plaster is put over them. The ceilings are of short pieces of terra cotta tile; loops of okonite wire are thrust between the ends of two adjacent tiles, and the ends bent at right angles to the line of the ends of the tile. These loops are in reality staples but they do not cut or abrade in the least the insulation of the conductors.

Double pole switches are used throughout. These switches are of special construction and so arranged that they cannot be tampered with. Each switch controls from 3 to 10 lights. Switch-boards are found on every floor.

There will be a 24 horse power motor in the top of the building and a 10 horse power motor in the basement, which will be used for the distribution of heat on the indirect radiation plan, and likewise for ventilation.

The cut on this page represents the main switch-board, which in design and workmanship is up to the standard of excellence maintained throughout the installation. The board is 13 feet long by 3 feet high. It is of one inch quartered red oak, bordered with a black walnut frame which sets it out from the wall about 6 inches. The number 000 wires connecting the three dynamos with the switch-board are so arranged as to divide the board into three sections, each dynamo running a section, or in case the lights required throughout the building are no more than a load for one machine, all the switches on the board or those that are necessary can be thrown in and current can be supplied from either one of the dynamos singly. Each dynamo is capable of furnishing lights of 16 candle power to 500 lamps and each section on the switch-board is provided with double pole switches of sufficient capacity to carry the current throughout the building. The cut shows three Ayrton & Perry voltmeters, one of which is connected to the dynamos. The board is wired throughout with okonite wire, ranging in size from number 12 to 000 B. & S. wire gauge.

How to Build an Eighteen-Light Dynamo.

In No. 16, Vol. III, of the WESTERN ELECTRICIAN a description was given of a small 18 light incandescent dynamo, built by C. E. Jones & Bro. of Cincinnati, O. It was stated that two purposes were in view in the design of this dynamo; first, to supply calls for small dynamos to furnish from fifteen to twenty lights; and secondly, to supply the castings to amateurs or others who wished to perform the work of winding and assembling the parts. It was intimated at the time the description was given that it would be referred to again. Instructions are now given for building this dynamo from parts furnished by the manufacturing company.

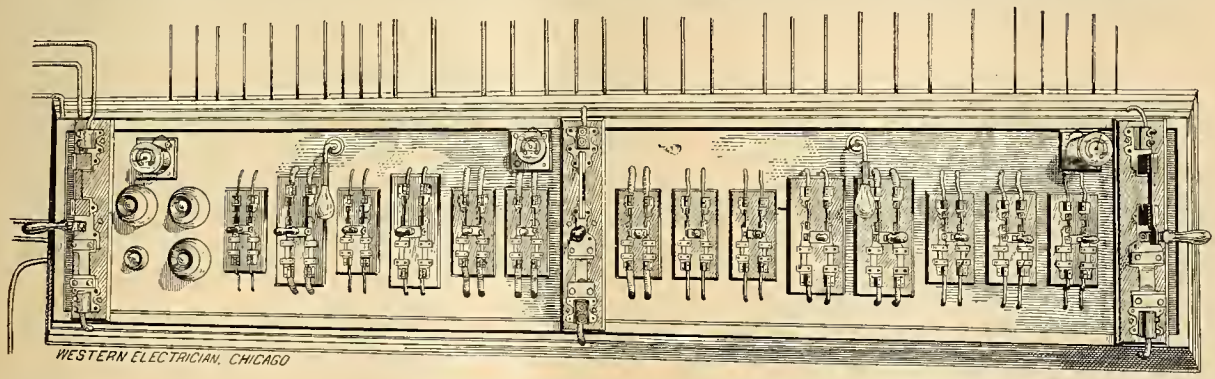

Fig. 1 shows the details of the dynamo, as follows: *A*, Casting of field magnets, yoke and base; *B*, two armature bearings; *C*, iron pulley; *D*, brush holders; *E*, commutator, copper sections, brass sleeve and collar; *F*, brushes; *G*, two bolts for bolting pole pieces to field magnets; *H*, four screws for bearing boxes; *I*, steel for armature shaft; *K*, wire for armature; *L*, wire for field magnet; *M*, fiber necessary for commutator; *N*, binding posts; *O*, twenty-four screws for commutator; *P*, two sight-feed oil cups; *Q*, four brass magnet heads; *R*, brass plate for securing pole piece; *S*, two pole pieces; *T*, two oil waste cups; *U*, 90 armature core plates; 200 paper washers for armature; in addition, 100 wrought iron rings and 100 paper washers, fiber for commutator, and 200 paper washers for armature are necessary.

Take the principal casting, which includes in it the base plate, magnet cores and their heel pieces, and bearing stands at either end of the base, or bed plate, and plane off the tops of the cores and bearing stands until the planed surfaces stand 7½ inches from the top surface of the base plate. Next plane the surfaces of the pole pieces which fit the tops of the magnet cores, and after having reamed the cored holes in the pole pieces to receive the ¾-inch bolts, and drilled and tapped corresponding holes in the magnet cores, secure them with screws to their places. Screw the brass plate to the tops of the pole pieces.

Bore out the pole pieces to 3 21-32 inches, being careful to have the center of the bore precisely two inches above the trued surfaces on the bearing stands. Next plane off the bottom surfaces of the bearing castings, so that the center of the cored hole shall be two inches from the planed surface.

In turning the shaft follow closely all the dimensions given in Fig. 2. At the shoulder, where thread is shown, chase 8 or 10 threads, 24 to one inch. At the points of the shaft, which come opposite the oil waste ways in the bearing castings, cut small grooves; this will prevent the oil running over the machine.

The workman is now ready to set the bearing boxes on their stands and babbitt them. Drill a ¼-inch hole on either side of both bearing castings, as shown in Fig. 3, and set the castings on their respective stands, so that the center of the cored hole will come as nearly as possible in line with the center of the bore in the pole pieces. Scribe through the ¼-inch holes on to the top surface on the stands, drill and tap for the cap screws, and firmly screw the bearing castings into place, having previously drilled a 5-16 inch hole in the top of each casting, to be tapped to receive the oil cups.

With boxes securely fastened down to their places on the stands, slip the shaft through until it occupies the position shown in Fig. 4. Carefully adjust it to the exact center of the bore in the magnet poles, supporting by means of blocks or other convenient means; this will leave a space in the holes of the bearing castings all around the shaft, which is to be filled by pouring molten babbitt metal through the hole where the oil cups are to go in, being first careful to put a little putty or soft clay about the shaft at either end of the boxes to confine the molten babbitt while it is being run. If directions have been carefully followed the operator will find that the shaft will revolve in the exact center between the magnet poles. Now remove the bearing boxes and pole pieces and prepare to wind the field wire.

To wind the field magnets, first make the spools or reels on which the wire is to be wound, using the cast brass heads, and sheet iron for the cylindrical portion, bending it so that it may be easily slipped over the cast iron magnet cores; solder the brass securely to either end of the sheet iron cylinder, making the outside length of the cylinder, with brass heads attached, rather less than 7½ inches, so that when it is slipped over the magnet pole and the pole piece set in place, the pole piece will be certain to seat onto the pole over its whole surface.

Next insulate these spools by covering the cylindrical portion with four thicknesses of heavy manilla wrapping paper, using shellac varnish freely between the several convolutions to hold it in place. Cut rings from manilla paper and paste with the shellac varnish four of these to the inside of each brass head, being careful to join these rings or washers at their inside edge with the paper covering on the body of the cylinder. Give the spools so insulated a good coating of shellac varnish, and allow them to stand until thoroughly dry.

When dry mount in a lathe, and wind on sixteen layers of number 18 Brown & Sharpe gauge, single cotton-covered magnet wire. For both spools this will require about 33 pounds, with a resistance, coupled in series, of about 42 ohms. Give the wire several coats of shellac varnish, and the field coils are completed.

Among the iron castings are two circular plates about $3\frac{1}{8}$ inches diameter by 5-16 inch thick. These are the plates which are to be fitted at either end of the armature core. Face off both sides of these plates until they have a thickness of $\frac{1}{4}$ inch. Turn off the edges until the diameter is three inches; round off one corner on each plate, over which the wire will bend when winding. Bore the hole in one plate $\frac{5}{8}$ inch diameter; this plate fits on the shaft against the 1 1-16 inch shoulder, as shown in Fig. 4. The other plate has a thread cut in the hole and screws onto the thread cut on the shaft. Now cut 24 radial slots, equi-distant, on the edge of each plate, $\frac{1}{4}$ inch deep and 3-64 inch wide. The operator can now commence building up the armature core. First set the finished cast iron plate, which has a smooth hole, on the shaft against the shoulder; then string onto the shaft alternately two paper washers and one sheet iron washer, until the space to the threaded portion of the shaft is filled, when the other cast iron plate is screwed on to the shaft. This plate must be drawn up closely, binding the whole mass of the core together endwise as tightly as possible. The distance between the outer faces of the two cast iron plates must be six inches.

The armature core, thus formed, must be carefully and thoroughly insulated by winding about it four layers of manilla wrapping paper, and also pasting disks of papers over the ends; in short, wherever the wire in winding would touch the core or shaft, it must be well covered with the paper, always using the shellac varnish freely. Cut away the papers covering the radial slots and insert pieces of fiber $\frac{1}{4}$ inch wide by about 3-64 of an inch thick, so that they will project radially from edge of iron plate, about $\frac{1}{4}$ inch.

The winding of the armature is most readily done in a lathe, as shown in Fig. 5. The armature shaft, with a dog attached, is supported between the centers of the lathe, with the dog in engagement with the face plate. A spool of number 16 double cotton-covered magnet wire is supported in a convenient position at the back of the lathe, and after binding the end of the wire around one of the wedges, leaving about four inches projecting beyond the wedge, the winding is begun.

The wire is carried by one hand along the surface of the armature core and through the space between the fiber wedges at the oppo site end of core, corresponding with the space in which the coil was started. The other hand grasps the face plate of the lathe, and as the wire is carried across the end of the armature

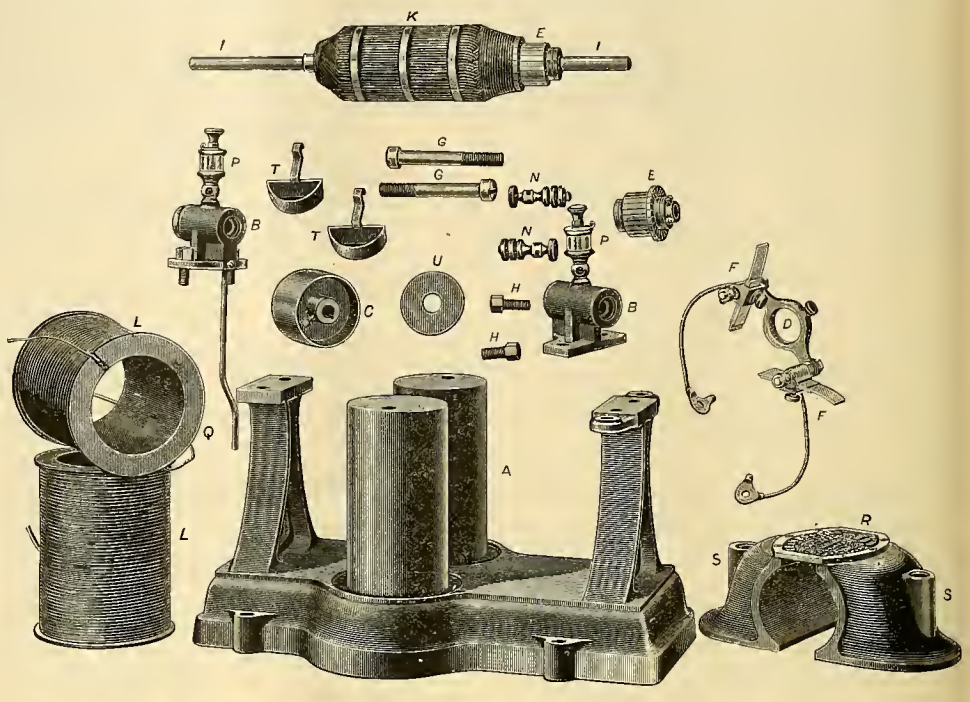

FIG. 1.

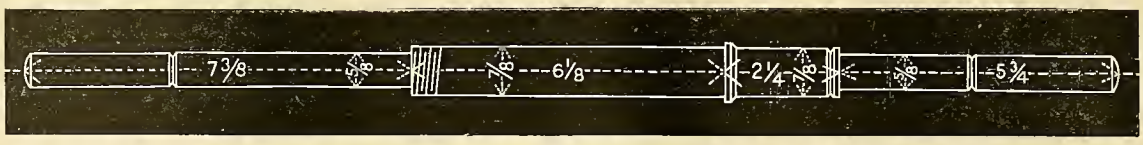

FIG. 2.

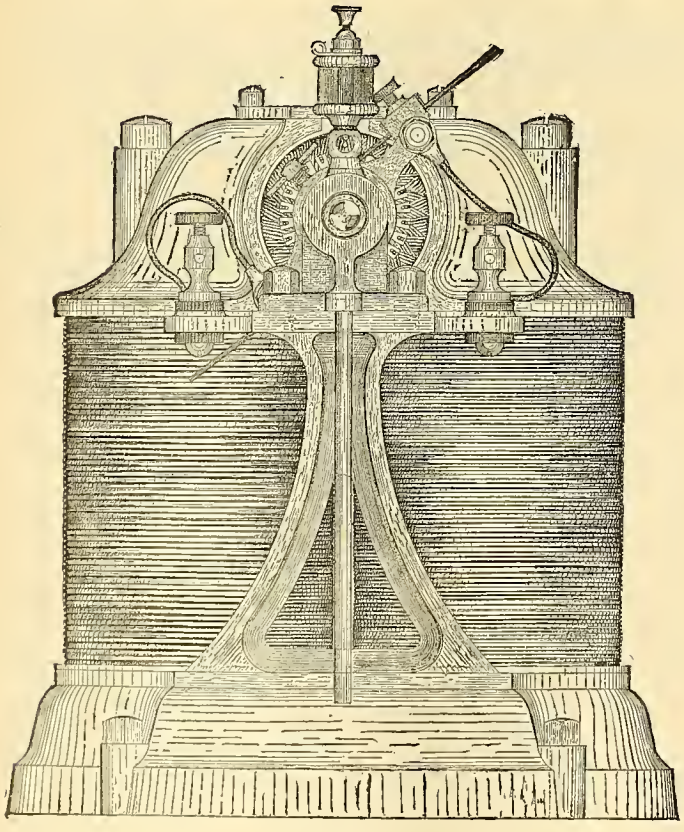

FIG. 3.

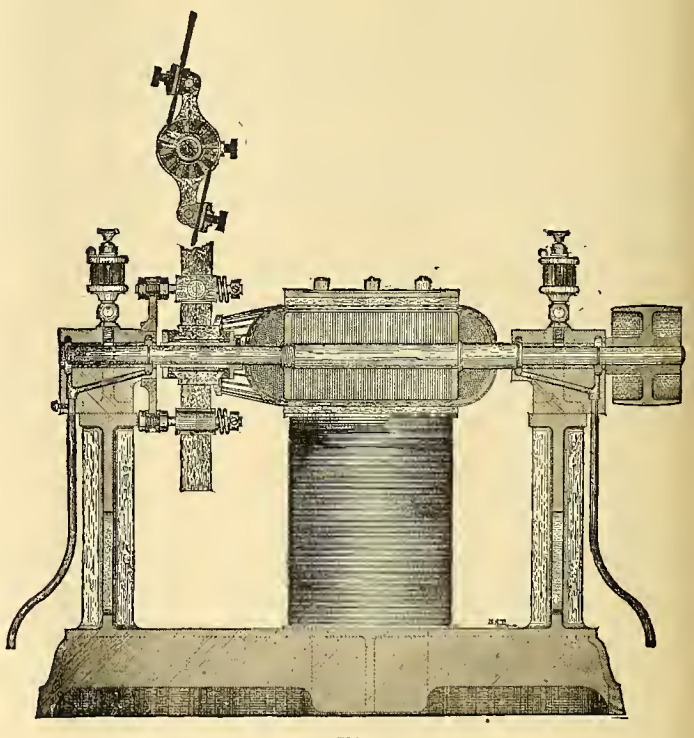

FIG. 4.

core, the face plate is dexterously turned through a half revolution, bringing the opposite side of the core uppermost. The wire is then laid between the two pairs of wedges diametrically opposite those embracing the wire on the other side of the armature. The wire is carried across the commutator end of the armature core, and the armature is returned to the position of starting by returning the face plate to its first position, and the wire is laid alongside of the portion first laid on. The wire is carried lengthwise around the armature in this manner until five parallel convolutions have been laid on. This layer of wire will extend across the space between two of the wedges. See Fig. 6. The inner layer, *B*, is represented as being raised from the core, to more clearly show the position of the wire on the armature, and the inner and outer coils are

FIG. 5.

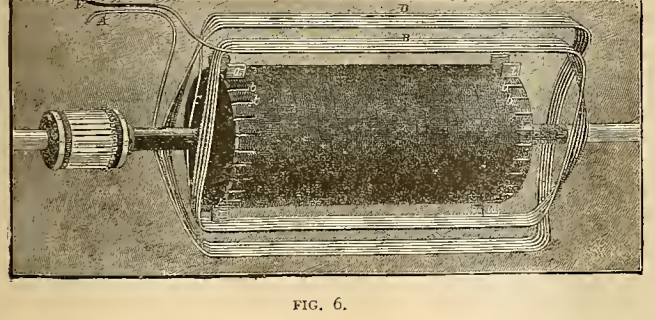

FIG. 6.

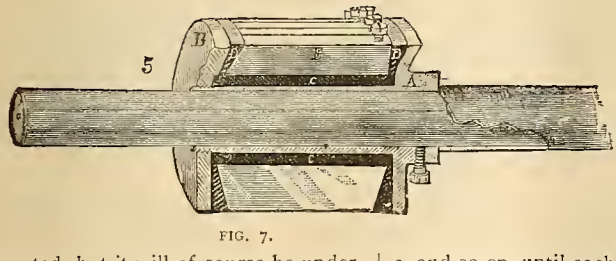

FIG. 7.

widely separated; but it will of course be understood that these wires are to lie as closely as possible to the core in the working machine. The beginning or inner terminal, *E*, of the coil *B* is represented in black. In practice, this end of the wire is always coated with colored varnish as soon as the coil is complete, and before the two ends of the coil are twisted together, as they always are temporarily, for convenience in winding, so that there cannot be a mistake as to which are the inner and outer ends of each coil.

After winding the inner layer of the first coil, the winding is continued, forming the outer layer *D*, on the top of the inner layer, by winding in the same direction, but returning by the successive coils of the second toward the point of starting. When the outer layer is complete the wire is cut, leaving a projecting end of about four inches long.

The colored or inner end of the wire is now twisted with the outer or uncolored end. In this manner, the first coil is placed in the spaces 1, 1 of the armature. It will be observed by reference to Fig. 8, that the two halves of each coil are arranged across the end of the armature on opposite sides of the shaft. This secures a compact end, and a minimum amount of dead wire.

After placing one coil in spaces 1, 1, in the manner described, spaces 2, 2, are filled in the same way, then 3, 3, and so on until twelve coils are wound upon the core. These coils half-fill all of the pairs of spaces 1, 1, 2, 2, 3, 3, etc., to 12, 12, with terminals *A*, *E*, projecting from each space around one-half of the periphery of the commutator end of the armature, the end of the armature presenting the appearance which would be indicated by Fig. 8, if the coils *G*, *F*, were omitted. When the armature is half-filled, the winding is continued in the same manner and in the same direction as before, forming a coil of two layers, *G*, *F*, in spaces 1, 1, on top of the first coil *B*, *D*, leaving projecting terminals, as in the case of the first series of coils, then a similar coil is formed on top of the coil in spaces 2, 2, and so on, until each pair of spaces contains two coils, one superimposed on the other, every coil being formed of two layers of wire, with five convolutions to each layer.

As a guard against the possibility of short circuiting, the terminals of each coil where they are in contact with each other or with other portions of the wire, should be provided with an extra wrapping of cotton or adhesive tape. To avoid the destructive effects of centrifugal force, the armature after winding is encircled at three equi-distant points in the length by three bands, each consisting of about 20 convolutions of number 22 hard brass wire, drawn tightly and soldered at several points; Fig. 9. A strip of canvas cloth should be placed around the armature under each band of brass wires to insure insulation.

The making of a good commutator is not the smallest item in the construction of a dynamo. It is a very important part of the machine and requires good workmanship and the best of materials. The commutator in a machine of this class is formed of a series of copper bars, separated a short distance from each other, and carefully insulated. On this eighteen-light dynamo it is two inches dia. and $2\frac{3}{4}$ inches long. The brass sleeve, *A*, Fig. 6, which is fitted to the shaft and provided with a fixed flange and a set screw at one end, is screw-threaded at the opposite end to receive the screw-threaded flange *B* to the sleeve *A*. Between the fixed flange and the removable flange *B*, is placed a vulcanite sleeve, *C*, and to the end of this sleeve are fitted two collars, *D*, of vulcanized fiber or analogous insulating material. These collars are beveled on their inner surfaces to the same angle as the ends of the copper bars, and thus are thickest at their peripheries.

The commutator bars are placed between the collars, *D*, *D*, in alternation with strips of fiber number 18, B. & S. wire gauge. The flange is then screwed up tightly, clamping all the bars and fiber strips firmly in their places, each bar being thoroughly insulated. The cylinder thus

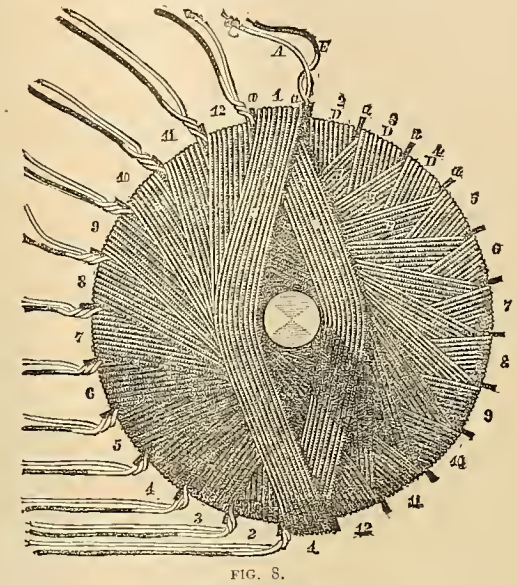

FIG. 8.

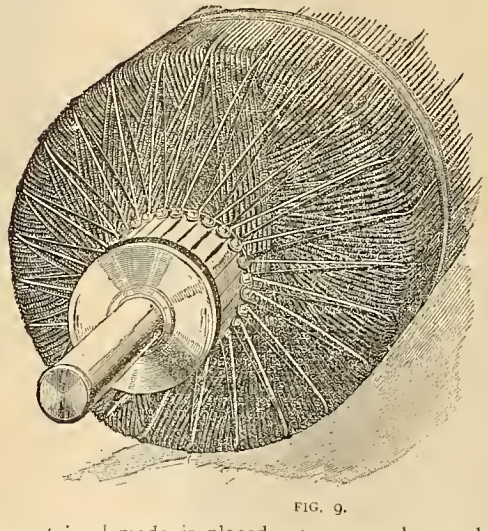

FIG. 9.

made is placed upon an arbor and carefully turned off to bring it to a true cylindrical form. After turning, each bar is drilled in the outer end of the radial projection to receive the screw by which the armature wire is connected to the commutator bar. The commutator cylinder, now finished, is secured by a set screw in its place on the armature shaft, with the screws adjoining the body of the armature.

Now, for the convenience in handling, the armature shaft is placed in the lathe, and the inside and outside terminals of one coil are carefully straightened out parallel with the sides of the armature, their ends are stripped of the insulating covering for a short distance and thoroughly scraped. The screws in two of the commutator bars, say 1 and 2 are loosened, so as to permit of placing the looped ends of two wires under them. The outer terminal of the coil is connected with the screw in the next bar in order in the commutator cylinder. The inner terminal of the second coil is connected with the screw last referred to, and the outer end is connected with the screw of the next bar in advance, and so on around the entire commutator cylinder, the outer end of each coil being connected

with the inner end of the adjacent coil and with a bar of the commutator cylinder by one of the screws as shown in Fig. 7.

The brushes which bear upon the opposite sides of the commutator cylinder are each made of ten strips of hard-rolled copper number 30, and one inch wide by four inches long. The brushes are clamped by means of a thumb screw in the mortised holder which turns freely on a stud. This stud is 5-16 inch in diameter and is rigidly held by the brush arm, but carefully insulated therefrom by means of fiber or hard rubber ferrules and washers.

The outer ends of the studs carry a small brass collar on which it is adjusted, and to which it is secured by a small screw. A spring is made by using hard brass wire, securing one end in the brush holder, taking two turns around the stud, and fastening the other end in the small brass collar. This provides a convenient means of adjusting the pressure of the brushes on the commutator.

After babbitting the boxes remove the one fitted at the commutator end of the machine, mount it on a mandrel driven through the babbitted hole, mount it in a lathe and turn a seat for the brush holder on the periphery of the inside end of the box, ½ inch back from the end and 1 5-8 inches diameter. Bore out the brush arm for a thumb set screw.

Drill a ½-inch hole through each of the projections at the top of the stand at the commutator end, and fit in the binding posts, insulated from the iron by means of bushings and washers of fiber or vulcanite.

Bore out the cast iron pulley, so that it fits on the shaft where it projects from the bearing, and secure in place by means of a set screw. True up the pulley on the outside and the machine is ready to be set up.

Fit the parts to their respective places; see that the armature revolves freely between the pole pieces with a clearance all around. No part of the copper wire or binding wire must touch the pole pieces. Connect the two inside ends of the two field coils and lead the outside ends to the two binding posts. Adjust the brushes in their holders so they will bear upon the commutator cylinder at points diametrically opposite each other, and at points about opposite the center of the space between the polar extremities of the field magnet. Carry a flexible wire cable from each brush holder to each binding post. Put on the belt and start the machine, driving the armature at about 2,200 revolutions per minute, revolving it in the direction of the free ends of the brushes. In the binding posts are inserted short wires which may be brought into contact with each other, momentarily, as the armature revolves.

If a spark is seen at the separation of the wires, it shows that the magnetism inherent in the iron is sufficient for the starting of the machine, and no further manipulation other than the adjustment of the brushes is necessary. The brushes should be adjusted to a point where the least sparking is produced. This will not vary much from the original position.

What is Electricity?

In a letter addressed to the London *Electrical Review*, W. H. Preece writes:

There is a something which we will call *A* that is not a form of energy. It is measured by coulombs. There is another thing which we will call *B* that is a form of energy. It is measured by watts. A coulomb per second is an ampere, as is also a watt per volt. *A* and *B* are thus related. A volt-coulomb is equivalent to a watt-second, each of which is clearly energy. A coulomb is, therefore, a factor of energy, while a watt is energy. Now when you assert that electricity is not a form of energy you apply the term electricity to *A*; when I assert that electricity is a form of energy I apply the term to *B*. Hence we are speaking of different things. If *A* were called coulombism and *B* alone electricity, or if *A* alone were called electricity and *B* wattism, or any other ism, confusion would cease; but as long as the term electricity is indiscriminately applied—

(1.) To the science of electrical phenomena,
(2). To one factor of electrical energy,
(3). To the ether which fills all space,
(4). To a mysterious something that permeates the ether,
(5.) To a form of matter purely imaginary and *sui generis*,
(6). To a something that is associated with each atom of matter,
(7). To a special fluid that has no real existence,
(8). To that form of energy which we call a current—*et id genus omne*,

so long will there be confusion and disagreement. I have given strong reasons why the term should be confined to that form that we manufacture and supply, that we buy and sell, that we measure and use, and that is understood by the public. The great step in advance that was chronicled at the British association at Bath was the fact that electro magnetic waves in the ether have been admitted and measured. There is nothing like the logic of measurement to dissipate error. I hope your readers will study Prof. Hicks' paper read at the same meeting. It opens quite another phase of the question. The material theory of electricity has now been exorcised to regions deep as e'er plummet sounded, and the mechanical theory has come to the front. The true question is not, What is electricity? but what is a coulomb? I do not attempt to answer the question, but I object to its being called electricity. I wish to restrict the use of the term electricity to the form of energy, which has an objective existence.

Bell Hangers' Hand-Book.

By F. B. Badt.

PART V.

ELECTRIC BELLS—Continued.

Chapter XXXVI.

Electric Bells—Continued.

Fig. 37 shows an electro-mechanical bell with the cover removed.

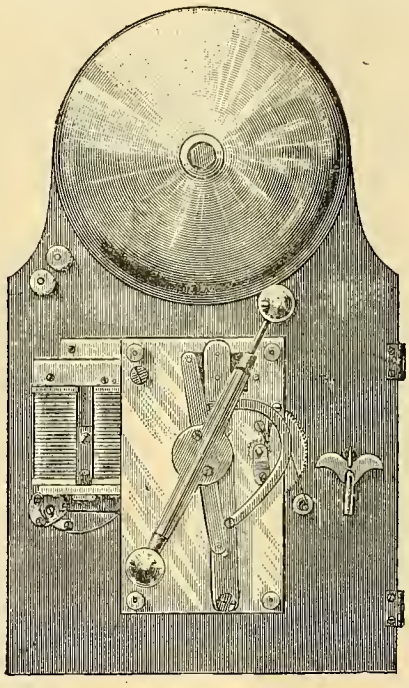

FIG. 37.

Fig. 34 is a diagram of the most simple installation of an electric bell.

Fig. 38 shows the arrangement of a single battery supplying several bells, actuated separately by different buttons.

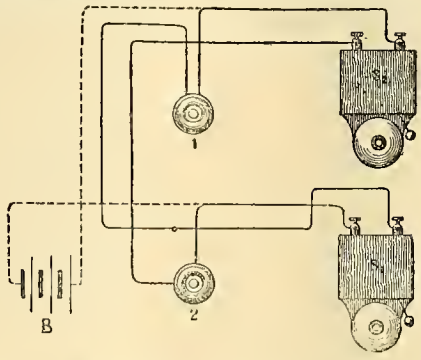

FIG. 38.

Fig. 39 represents a battery B, acting on a bell S, put into motion by three different buttons, 1, 2, 3.

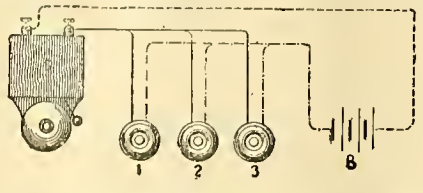

FIG. 39.

By means of three wires and one battery, it is possible to fix two buttons and two bells, so that by pressing button 1, Fig. 40, the bell S_1 alone rings, and button 2 only rings the bell S_2. The diagram will explain the connections.

This system may be used to transmit certain signals like the telegraph, but its use in that direction is limited.

Chapter XXXVII.

Long Distance Call Bell System.

For transmitting calls to a long distance, the system outlined in Fig. 41 is used. Only one wire is employed, the

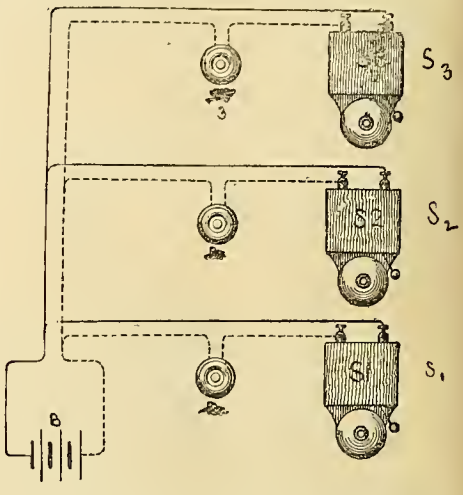

FIG. 40.

ground being used as a return. This method is used to save the cost of the wire for the return. Two separate batteries are employed, one at each end of the line, which are always open and only in operation at the moment of signaling. For this system, bells having a resistance of at least twenty ohms should be used. The number of cells required

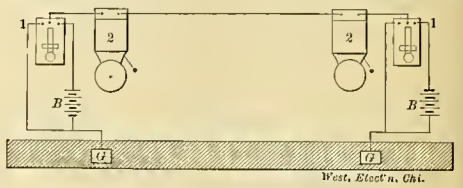

FIG. 41.

for each battery will be according to the distance of the stations from each other. For less than one mile, six cells at each end will be sufficient battery. In the diagram 1 is a double contact key and 2 is the bell, *B* the battery and *G* is the ground connection at each station, respectively.

It will be seen that the arrangements of electric bells may be varied indefinitely, and do not give rise to any serious difficulties if a little care be taken.

Chapter XXXVIII.

Push Buttons.

The range of style, shape and construction of push buttons is almost limitless. They are made both in wood and

FIG. 42.

metals of various kinds. Every day sees new styles manufactured and any well assorted stock offers a range of choice from the common, cheap wood push button to that of the

FIG. 43.

most artistic handiwork; the one for a barn, it may be. the other for a palace.

A few designs are shown. Fig. 42 represents a wooden push button; Fig 43 a nickel plated button; Fig. 44 a

FIG. 44.

bronze button; Fig. 45 a pear shaped button; Fig. 46 a compound call button, the purpose of which is evident. Fig. 47 represents a floor key. This is a push button in principle, and is properly classed under this head. It is inserted in the floor, as under a dining table, and connects with a bell in the kitchen or servants' room. A pressure of the

foot upon the projecting pinion closes the circuit, and causes the bell to riug.

FIG. 45.

FIG. 46.

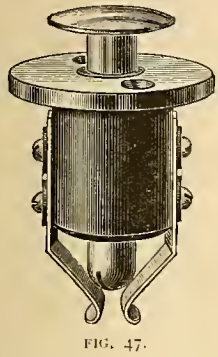

FIG. 47.

Fig. 48 shows a combination of a floor key and a push button. The purpose is plain. The floor key can be used

FIG. 48.

as such when desired, or in case necessity requires it, the cord can be attached, first removing the center pinion and the push button can then he placed where desired.

CHAPTER XXXIX.

The Buzzer.

FIG. 49.

In many cases the sound of a bell is found to be louder than is desirable. This objection is overcome in tbe buzzer, an instrument in which the vibrating hammer strikes a sounding piece, producing a distinct humming or buzzing sound. It is often used to call a clerk or messenger from his desk without directing general attention to the call. Fig. 49 shows a well-known form of this instrument.

ANNUNCIATORS.

CHAPTER XL.

Annunciators.

The general directions given for the connecting electric bells apply equally to annunciators.

These instruments are made for a variety of different

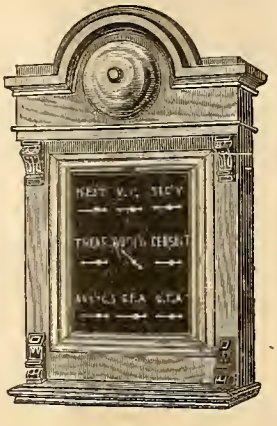

FIG. 50.

places. Fig. 50 illustrates an office call annunciator; Fig. 51 a hotel annunciator; Fig 52 an elevator annunciator.

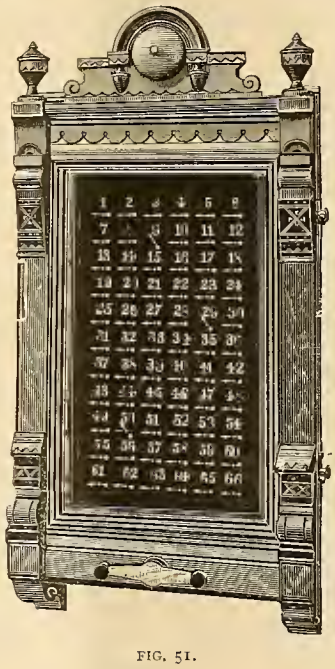

FIG. 51.

Fig. 53 is a simple diagram showing how the circuits between push buttons, battery and the annun-

FIG. 52.

ciator are run. The position of the annunciator is indicated: *B* indicates the battery; 1, 2, 3 and 4 are push buttons; 5 is a floor key and 6 is a separate electric bell in circuit with the same battery that actuates the system within the house.

The indications on the face of the annunciator, of calls sent from various points, are made in different ways; frequently by needles which change from their normal position when they are actuated by the closing of a circuit, as indicated in Fig. 50, where it is plain the attendant is desired in the auditor's office, and Fig. 51 where calls are recorded from rooms 9, 29 and 50; frequently the call is recorded by a drop or shutter which normally is in a nearly vertical position but when the circuit is closed by pressure on a push button the drop falls and discloses a number or name.

In the illustration shown, each individual annunciator, as distinguished from the whole instrument which is also

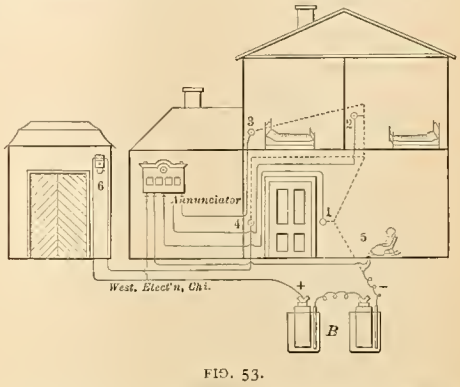

FIG. 53.

called an annunciator, consists of a little electro-magnet, and an armature which is attracted when circuit is made by pressing the corresponding push button; as soon as the armature moves, a little lever is released which turns over by its own weight and moves the pointer on the face of the annanciator. A vibrating bell connected in the return wire, leading to the battery, rings at the same time After the attendant has noted who has called, he moves a lever on the bottom of the annunciator box which pushes the little lever again in its place so it is held by the armature of the electro-magnet. There are innumerable constructions but the principle is the same in almost all of them.

ELECTRIC ALARMS.

CHAPTER XLI.

Electric Alarms.

Alarms are apparatuses to warn of an impending danger or accident either to property or human life, or to both. Their number and arrangement may be varied indefinitely, but we can describe here only a few examples. There are hundreds of new inventions in this line every year.

Alarms may be classified into those operated by hand—hand alarms—and those which operate automatically—automatic alarms.

CHAPTER XLII.

Hotel Fire Alarm and Room Call.

Inventive genius has done much to lessen the danger in case of fire, but until the introduction of the hotel fire alarm no absolutely reliable means had been invented for arousing every sleeping guest in a burning hotel, no matter how large the structure.

Fig. 54 represents a hotel fire alarm and room call ap-

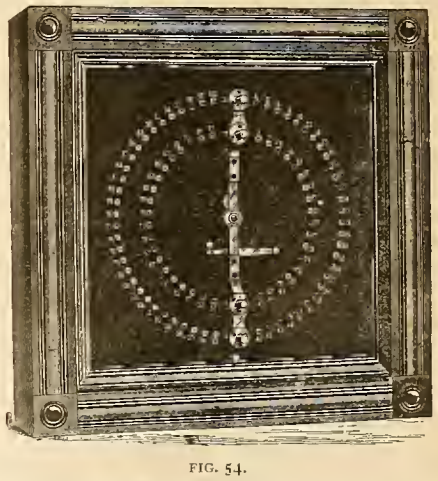

FIG. 54.

paratus, which is placed in the office. In each room of the hotel there is a bell which is connected with the series of push buttons shown in the cut. By simply releasing a lever or arm the bell in every room is rung twice during each revolution of the lever, and the revolutions continue until long after every guest has safely left the burning building. This alarm is automatic only from the moment the clerk or attendant starts the lever.

This system, on account of its ingenious and reliable construction, can always be depended upon as a fire alarm. No large battery is required to operate it, and its daily use as a room call is a constant test of its readiness for use in case of fire.

(To be continued.)

The Royal Scottish Society of Arts at Edingburgh, has awarded J. Hart Robertson of Rutherford, N. J., the Keith medal with money to the value of £30 for his invention of the writing telegraph.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

PAGE.

A Model Brush Plant, Illustrated 241
How to Build an Eighteen-Light Dynamo, Illustrated, ... 241, 242, 243, 244
What is Electricity? 244
Bell Hangers' Hand Book; by F. B. Badt, Illustrated, Part V:
Electric Bells, continued 244, 245
Annunciators 245
Electric Alarms 245
Editorial 246
New Telephone Exchange System, Illustrated 247
The Sioux City Corliss Engine, Illustrated 248
A New Species of Obstructionist, Communication by W. M. C. Ryan 248
The Electric Launch Viscountess Bury 248, 249
The Julien Companies 249

DEPARTMENTS.

Correspondence 249, 250
The Electric Light 250, 251
The Electric Motor 251
The Telephone 251
The Telegraph 251
Electrical Patents 252

ONE of the officers of Cleveland electric road thoroughly believes that the day of the street car horse has passed. He predicts that within five years all street railways in the country will employ electric motors.

HOUSE movers seem to consider that electric companies maintaining overhead wires, have no rights which they are bound to respect. Frequently they deliberately tear down a score of wires in their operations. The last accident of the kind occurred in Detroit, where a house mover destroyed an electric light tower and nearly caused the death of a lineman. Action should be taken to make these street obstructionists more careful.

A CORRESPONDENT of the *Engineering and Building Record* has written a communication urging municipal authorities of country towns to erect electric light plants. He writes: "The investment required is usually comparatively small, and the difficulties to be encountered in operation and management are insignificant. The result to the public would be a much better illumination of hundreds of small towns now sparsely lighted with naptha or gas at, in very many cases, a less cost."

THE Cushman Telephone company of Chicago filed a petition last week praying that a rehearing be granted in its suit with the Bell company. This is the action which Judge Blodgett decided against the Cushman company. The petitioners assert they are confident of ultimate success. Dr. Cushman says he has never for an instant lost hope. On the other hand, it may be said that the officers of the Bell company say their opponents are doomed to defeat beyond all question. The Cushman company offered as grounds for a rehearing the claims that the court had evidently misapprehended many material facts in proof; had failed to carefully consider many material and important facts established by proof; had drawn conclusions not warranted by the proofs; had erred in the application of the law to the facts, and that newly discovered evidence could be produced. Judge Blodgett allowed the Bell company two weeks to file its answer. There will be no oral hearing of the motion.

IN the annual report of Admiral Porter this interesting paragraph appears: "The torpedo no doubt, can be made a powerful adjunct to other naval appliances, but as matters now stand the torpedo would be comparatively useless against heavily armed ships with powder guns, which would hold their own, notwithstanding they might be hampered with nets enough to keep out a torpedo. Great ships with great guns will command the situation, and having once effected an entrance into the harbor, can, by the aid of electric lights, send a party of divers to the bottom and cut the wires connecting submerged mines."

A NEW telephone exchange system, devised by Charles E. Scribner, is shown in this issue. It has the merit of being simple, and at the same time a great improvement upon existing systems of this class. Mr. Scribner is without question the most prolific inventor in the line of telephonic appliances in the world. He has already secured over eighty patents, and has about seventy more pending. Some of the most valuable patents in this line are the products of his inventive genius. He is a remarkable man. Though still young in years his inventions have won for him a world-wide fame, and his name in telephonic history is bound to live so long as switch-boards and telephonic appliances are known.

UNLESS St. Paul papers are greatly mistaken, the construction of the Northern Michigan railway will have an important bearing on the copper market. For years it has not paid to work a number of mines in Ontonagon county, as the metal could not be brought to the market. A correspondent writes: The completion of this projected rail line will allow the re-opening of many of the Ontonagon county mines. More important than this, many new mines will be opened in the territory which the new road will traverse. If the French syndicate has really contracted with the leading copper mines of the world for their product during the coming nine years, as now seems probable, the Frenchmen will find that they have an elephant on their hands, even though the product of mines now working is to be restricted one-sixth. The new copper range to be thrown open to development by the Northern Michigan railroad, will prove an important factor in the copper situation. With copper selling at thirteen cents to the syndicate, the mines to be opened in the new district can produce many thousand tons annually in a very few years.

SEVERAL lawyers in New York city have announced their intention to test the constitutionality of the law providing for electric executions if unfortunate clients should be condemned to death next year. The law provides that the new mode of inflicting the death penalty shall apply only in cases of homicide committed after January 1st next. Hanging will still be in force in cases of murders committed before January 1st. Several lawyers question the legality of the coexistence of two death penalties. Other attorneys claim that electric executions are illegal because they are "cruel and unusual." District Attorney Fellows and his assistants have views just the reverse of those expressed by the lawyers quoted. They maintain that there will not be two death penalties in force, in so far as any specific crime is concerned. As to the murderers now in the Tombs only hanging applies, and as far as they are concerned there is no death by electricity. As to the "cruel and unusual" claim, the district attorney says:

"The intent of the lawmakers governs here. The fact that a punishment is unusual does not alone make it unconstitutional—it must also be cruel, and the legislature intended that when the current is passed through the body of the murderer it shall be so powerful that it will kill instantly."

A CURIOUS question regarding the telephone has arisen among the bishops of the Catholic church in France and that is whether a penitent can confess and be absolved by telephone. It is admitted that the pope can bless by telegraph and dispensations transmitted by cable across the Atlantic are far from infrequent. French bishops, according to a correspondent, are against absolution by telephone but appeals from their authority have gone to Rome and holy office must settle the matter. One priest, an Italian, and by the way the subject has received some consideration in that country, takes the ground that "telephony lengthens the human ear for miles, and suppresses distance for the voice. Being within earshot is being, for confessional objects, present." It strikes us that if priestly offices can be transmitted by telegraph, there is much less objection to the telephone where the words of absolution, consolation or dispensation are transmitted, not by a written message passing through profane hands it may be in the course of business but directly from the mouth of one of holy office to the communicant. The question is one of sentiment only it seems to us, and as between the the telegraph and telephone, the latter should have the preference. Nevertheless, and without irreverence it is written, we do not believe the church should be converted into a telephone exchange as an intermediary of communication between priest and communicant. The matter is an illustration of the effect the more recent developments of electricity are having upon the social system.

AN exchange remarks that "the press is continually chronicling launches of electric boats, and also tells the many advantages to be derived therefrom. Until electricity is much more widely distributed than at present, the usefulness of electrical boats will be limited. As tenders for large steamers having dynamos on board electric launches will sometimes prove handy, but for pleasure trips they will hardly prove desirable. Coal burning steamboats can proceed with wood, or almost any other variety of fuel, when out of coal, but electric boats are more particular, and will use no other propelling power than electricity, hence the awkwardness of 'running short of lightning' when away from the vicinity of an electric light wire. For short ferry courses and similar water travel electric boats will prove all that is desired. The accumulators can be charging while the boat is taking and delivering freight and passengers, and thus the steam plant may all be maintained on shore, and running almost continually, a much smaller plant will be necessary to do the work than when marine engines are used in the boats."

Electricity has shown its ability to supply a better illuminant than gas at a less cost; electricity is proving its ability to displace the street car horse, and will in time be largely used in the very manner indicated in the extract, that is, on boats. The millenium has not arrived in any of the departments outlined, but the way to attain it, in so far as it can be attained, has been indicated by electricians.

Without discussing the possibility of generating electricity in some cheaper way than by the modern dynamo and storing it for use, but confining attention solely to present conditions, the system now in use on boats propelled by electricity, of first generating electricity and storing it in accumulators, presents decided advantages over any coal, wood or oil burning apparatuses for small boats. There is absence of smoke, cinders and heat, and an economy in space taken up by steam generating plants. At present there have to be coal or wood or oil supply stations for boats that are propelled by steam engines, and when the time arrives for a general introduction of electric boats, the necessary current for recharging cells, we take it, will be as readily as accessible as fuel supply stations are now.

New Telephone Exchange System.

Among the patents recorded last week was one to Charles E. Scribner of Chicago for a telephone exchange system. The invention, illustrated by the accompanying cuts, relates to that system of telephone exchange in which the subscribers' telephone lines are grouped or connected through a common line at the central office, in which is placed a telephone. With this system the common wire is grounded at the central office, and the outer ends of the wires connected to the common line. But the number of subscribers which may be advantageously included in a group is limited, as at each subscriber's station, when a call is made for the central office, a ground connection is made, and if, say, five subscribers call at the same time, there are six ground connections, one at each station and one at the central office. Therefore the voice current sent from any one of these stations is divided, and passes to ground in derived circuit at five other ground points. If, however, the common wire at the central office, instead of passing to ground, is connected with the other hand, in case all the telephones of one group are hung up so that there is no ground connection with the group, telephonic communication may be maintained between any subscriber of the other group and the listening operator, since the first group, when disconnected from the ground, acts as one plate of a condenser.

The invention consists in the method of operating telephone exchanges, whereby the condenser capacity of two groups thus connected to the opposite ends of a common wire is taken advantage of to enable any subscriber of one group to communicate with the listening operator having his telephone included in the common wire, and also in grouping the subscribers' lines on opposing sides of the wire containing the listening operator's telephone outfit, thus dispensing with the ground connection at the central office.

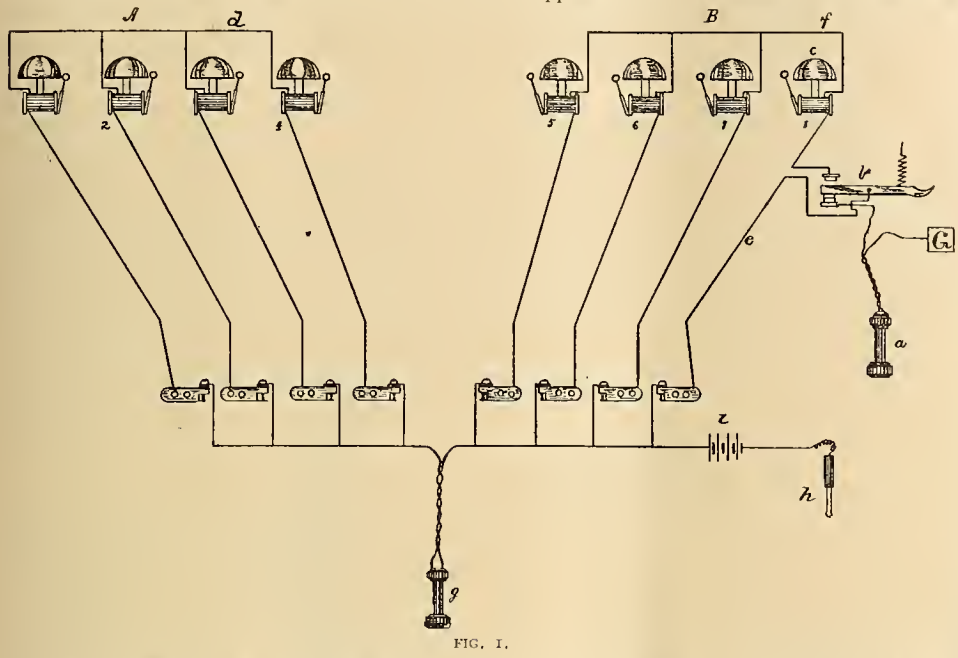


FIG. 1.

In Fig. 1 it will be seen that there are two groups of telephone lines connected with the same switch-board at the central office and thence to a common line, including the operator's telephone *g*. The telephone lines of the stations 1, 2, 3, and 4 constitute group *A*, and the telephone lines of stations 5, 6, 7 and 8 constitute *B*. There may be in practice, say, from twenty to twenty-five lines in each group. At station 8 is shown a subscriber's outfit consisting of telephone *a*, switch *b*, and bell *c*. Any other subscriber's outfit may be used at the different subscribers' stations. The outer ends of the telephone lines of group *A* are connected with the common line *d*, while the outer ends of the telephone lines of group *B* are connected by the common line *f*. There are normally no ground connections except when the subscribers remove their telephones from the switches. When a telephone is thus removed from a switch, as shown at station 8, the telephone line *e* will be disconnected from the bell *c* and the common line *f* and closed to ground, as shown through the switch *b* at that station. The subscriber on taking down his telephone may speak at once to the operator listening at telephone *g*, the condenser capacity of group *A* being sufficient to allow the voice current sent from station 8 to operate the telephone *g*, although there may be no ground upon group *A*. Suppose subscriber 8 asks for subscriber 2. The operator, on being informed of the connection desired, by inserting plug *h* in switch 2 sends current from the negative pole of battery *i* over line *k*, through bell *l* at station 2, Fig. 2. The current, after passing through the bell, finds circuit back to the positive pole of the battery by common line *d*, and such telephone lines of group *A* as happen at the time to be connected with the common line. The current after passing through bell *l*, being distributed through several different telephone lines, will not be strong enough in any one line to ring the bell included therein. The bells may be polarized, if desired, so as to respond to current in but one direction. Subscriber 2 will thus be notified by the ringing of his bell and will at once take down his telephone from the switch, and then the switch will automatically assume the position shown at station 2 in Fig. 2. Line *k* will thus be disconnected from the common line *d* and closed to ground through the telephone at station 2, as shown. The plug *h* is then removed, and subscribers 8 and 2 may then be connected by a flexible cord provided with terminal plugs, as shown upon the switch-board at the central office in Fig. 2. Any two subscribers, whether of the same or opposite groups, may thus be connected. Lines when thus in use are cut off from the listening operator's telephone. A clearing-out drop may be included in the circuit of the connecting cord in the usual manner. Lines in use, therefore, are thus insulated from the other lines of the system. If, however, several subscribers take down their telephones at the same time to speak to the listening operator, there will be a ground connection established at each station of the subscribers who are thus asking for connection; but as the lines are distributed in groups on different sides of the telephone *g* it will in practice never happen that so many lines of one group will be grounded as to interfere with the successful working of the system.

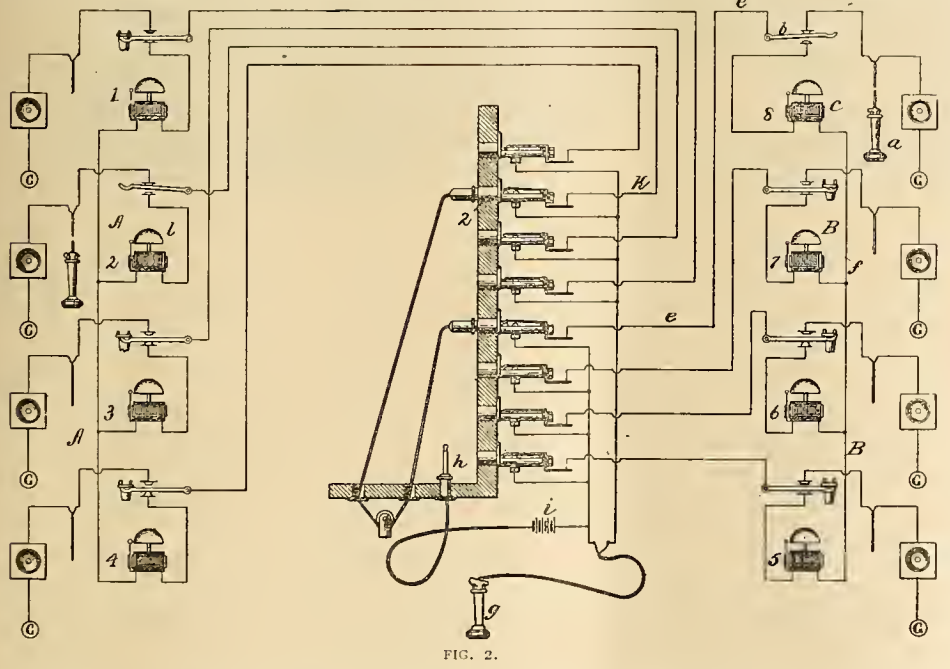
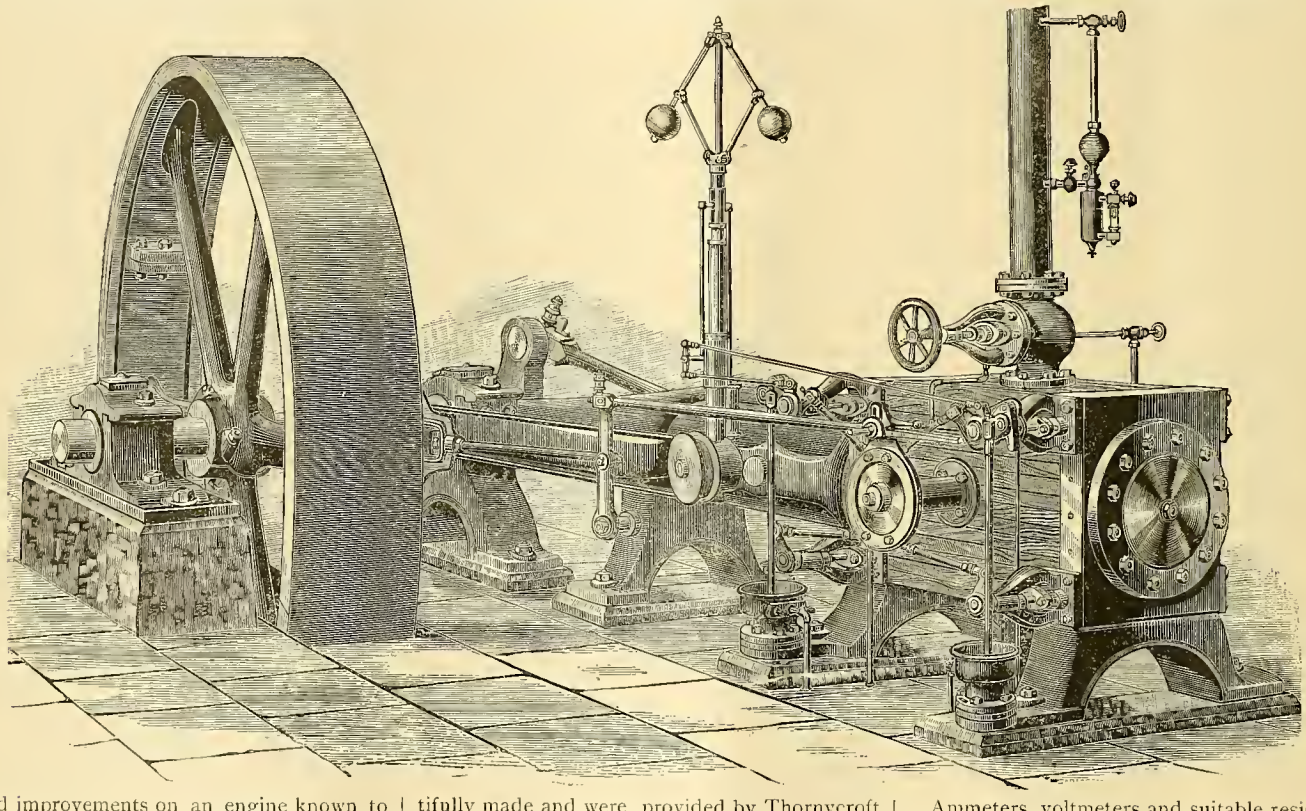


FIG. 2.

The Hon. C. A. Parsons describes in a communication to the Royal society a number of experiments which he has recently made on carbon at high temperatures and under great pressures, and in contact with other substances. The primary object of the experiments was to obtain a dense form of carbon for use in arc and incandescent lamps. Though the experiments were not entirely successful, it would appear that the author of the paper succeeded in producing diamond dust artificially. The arrangement of the experiment was as follows: A massive cylindrical steel mould, of about 3 inches internal diameter and 6 inches high, was placed under a hydraulic press; the bottom of the mould being closed by a spigot and asbestos rubber packing—similar to the gas check in guns. The top was closed by a plunger similarly packed; this packing was perfectly tight at all pressures. In the spigot was a vertically bored hole, into which the bottom end of the carbon rod to be treated fitted. The top end of the carbon rod was connected electrically to the mould by a copper cap, which also helped to support the carbon rod in a central position. The block and spigot were insulated electrically from the mould by asbestos; and the leading wires from the dynamo being connected to the block and mould respectively, the current passed along the carbon rod in the interior of the mould. The free space in the mould was filled in turn with different hydrocarbons and with other materials. Among the liquids acted on were benzine, paraffine, treacle, chloride and bisulphide of carbon, and the solids included silica, alumina, carbonate and oxide of magnesia and alumina. The pressure employed ranged from five to thirty tons per square inch. In the experiment with silica the density of the carbon was increased 30 per cent., and in no other case. The most interesting set of experiments was when the mould around the rod was filled with a layer of slaked lime about one-fourth inch thick, surmounted by two inches of silver sand, followed by a layer of lime of the same thickness, and finally by a layer of coke dust. The pressures used ranged from five to thirty tons, and the current from 200 to 300 amperes, the carbon being in different experiments from one-fourth inch to five-sixteenths inch in diameter. Under these conditions there was obtained on the surface of the carbon rod a powder of a gray color, harder than emery, and capable of scratching the diamond. This powder is, therefore, very probably the diamond itself.

The Sioux City Corliss Engine.

The illustration on this page represents the style of Corliss engine made by the Sioux City Foundry & Machine works of Sioux City, Ia., for central station electric lighting and power plants. The manufacturing company originally did business under the name of J. P. Dennis & Co., beginning business in the year of 1871, and doing a general jobbing business up to the year of 1884, at which time the works were incorporated, with J. P. Dennis, now deceased, as its president. The company commenced the manufacture of the style of engine shown, and has built a large number, furnishing them to various branches of business throughout the northwest. In December last the company suffered by death the loss of its former president, J. P. Dennis, who was the mechanical manager, and to whose untiring energy the firm owed a large measure of its success. It was then deemed advisable to extend the scope of the works by the addition of men especially skilled in steam engineering, and C. M. Giddings, mechanical engineer, for several years superintendent of the engineering department of Russell & Co., took an interest in the company, and accepted the position of general manager, selling to the company the shop right for the manufacture of his designs and



patented improvements on an engine known to the trade as the Russell single valve automatic engine. The services of H. J. Westover were also secured. This gentleman was formerly connected with Russell & Co. as mechanical engineer, and previously held an important position in the engineering department of E. P. Allis & Co. of Milwaukee, builders of the Reynolds-Corliss engine.

A New Species of Obstructionist.

Editor WESTERN ELECTRICIAN:

ANNISTON, Ala., Oct 27.—As illustrating the perilous nature of the "wire slingers'" occupation in the land of cotton, the following may be of interest: Last Friday I had two negro linemen at work on a country road about two miles from town. They attracted the attention of a farmer bringing in his cotton, who, under the delusion that their climbing spurs were a new form of shackle, posted off for a marshal, with whose assistance and that of a pair of somewhat time-worn shot-guns, he proceeded to arrest the harmless pair, believing them to have escaped from a chain-gang. His astonishment when the situation was explained, was "picturesque." He was equal to the occasion though, remarking that "This totin' lightnin' around is dangerous any way, and orter be made a penitentiary offense."

W. M. C. RYAN,
Manager the Southern Bell T. & T. Co.

The new electric lights in the St Louis postoffice were set in operation last week, and worked perfectly. The pipes in which the electric wires and gas pipes are concealed are an ornament to the working tables.

The Electric Launch Viscountess Bury.

The Viscountess Bury was launched from the builder's yard, Strand-on-the-Green, Chiswick, on Monday, October 8th, says the London *Electrical Review*. This is the largest electrical boat which has yet been seen on the Thames, or probably in the world, if we except that of Mr. Elieson. She is intended for public use, and will carry upward of eighty passengers comfortably.

The Viscountess Bury has been specially designed and built for a private company by W. Sargeant, electrical launch architect and constructor, Chiswick, Middlesex. She is 65½ feet long with 10 feet beam and has a mean draught of 22 inches, with a displacement of 12½ tons. The hull is constructed of three skins, the inner being diagonal, and outside planking of bright mahogany in narrow widths. The keel, which runs from stem to taffrail, is in one length of American rock elm. Dead wood aft has been in this instance entirely abandoned, the object being to assist the steering in narrow bends up the River Thames, and for giving a clear run, and to get greater efficiency from the twin three-bladed propellers, which are built up of steel to a 12 inch pitch and 2 feet 3 inches diameter, rotating outward, and calculated to revolve at 600 revolutions per minute. These propellers are beautifully made and were provided by Thornycroft & Co., the torpedo boat builders of Chiswick. Mr. Sargeant has designed a rudder on an entirely new principle, with the object of clearing weeds, obviating stern post dead wood and gudgeons, with facilities for quick removal and easy steering. This rudder will be built up of thin steel, galvanized, and slung in a gun-metal trunk. The steering wheel is situated forward on the deck, so that the man operating has full view of all small craft which so numerously frequent the higher reaches of the Thames in summer. Adjoining the steering wheel will be an indicator communicating with the electrician in charge of the switches controlling the electrical power.

The electrical energy is stored in 200 Electrical Power Storage company's accumulators of the "1888" type, each of which has a capacity of 145 ampere-hours with a discharge 1 to 50. The midship section of the vessel being perfectly flat, there will not be any lids to these boxes, so in the event of her taking the ground the acid will not slop over. These storage cells are arranged, one hundred on each side of the vessel, under the seats. The space occupied by them is lined with lead, small drains leading into receivers in case of accident, thus securing perfect dryness for the boxes. The cells are computed to hold electrical energy sufficient with one charge to propel the vessel for 10 hours, at a speed of six miles per hour, as regulated by the Thames conservancy by-laws. There are two 7-inch Immisch motors, which convert the electrical energy into power. These are calculated to develop 7½ brake horse power at 1,000 revolutions per minute. They are placed under the floor aft, each working direct on to one of the twin propeller shafts. The thrust is taken from a ball-bearing thrust block, which reduces the friction greatly. The switches are fixed, port and starboard, and are two to each motor, one for half and full speed, the other for going ahead or astern. They are worked by the electrician in answer to bell signals from the man at the wheel. Each propeller can thus be worked independently of its twin companion, and so greatly assist the steering in sharp bends of the river.

In place of the objectionable whistle of the steamers a large and melodious ship's bell is placed on the cabin top, and may be sounded electrically by the man steering, the current coming direct from the accumulators. This bell will sound for warning boats and signaling lock-keepers.

All lights for port, starboard, masthead and cabin lavatories, etc., will be incandescent electric lamps supplied by the accumulators.

Ammeters, voltmeters and suitable resistances are all under the immediate sight or control of the electrician. All the machinery being placed below the floor, leaves a clear space from stem to stern for passengers.

The cabin is furnished with a ventilating lantern, and is placed amidships with lavatories, etc. The upholstering is of crimson embossed velvet, the paneling is of moulded teak, bright varnished throughout, the ceiling being moulded and picked out in gold and white. In the center is the dining table, and seats run all round the cabin, which is 10 feet long, with folding flaps on each side.

The windows are of engraved plate glass, and those of the ventilators amber in color. The fore and aft parts of the vessel are of bright teak and upholstered with portable seats, so that the accumulators may be very easily examined in caseof necessity, or at the time of charging them.

Mr. Sargeant designed another electrical launch, the Malden, which, during the past summer, was a familiar object of interest on the Thames, especially during the Henley regatta. The Malden is 30½ feet long, with 4 feet 10 inches beam. She was constructed chiefly for experimental purposes, and upon her trials data of great interest have been obtained. On one occasion, with a single charge, the Malden was

propelled 56 miles down stream at about 10 miles per hour.

This boat was built by Maynards of Chiswick, under the superintendence of the designer. The propeller is double bladed, 2 feet diameter, by Thornycroft & Co.

The motor is a 6-inch Immisch machine, driving the propeller at 550 revolutions per minute, from 48 accumulators.

For the convenience of charging these vessels, Mr. Sargeant designed a floating station. In outside appearance it is much like a large "house boat" of the Thames. It consists of a large river barge, 70 feet long by 14 feet beam. On the floor, upon a suitable foundation, is placed a semi-portable steam engine of 25 nominal horse power, with counter shafting. This drives dynamos, which, through insulated copper leads, supply the current to the accumulators in the launches. There are also on board an instrument room, office, engineer's room, stores and sleeping accommodation aft. This station, which has already been mentioned in the *Review*, was a conspicuous object at the last Henley and Maidenhead regattas, when among its other duties it lit up the course in the evenings with an arc lamp, incandescent lamps being used on the station for lighting the various rooms.

Electric propulsion for river launches is likely to become an established fact on the Thames, and Mr. Sargeant has other boats in course of design and construction.

The Julien Companies.

The Julien systems of electric lighting and electric traction are being introduced and operated under two distinct companies: The Julien Electric company and the Julien Electric Traction company.

The Julien Electric company devotes itself exclusively to the manufacture and sale of storage battery for lighting and stationary power. To this end, it has a large factory in Camden, N J., which is being run overtime at present in order to supply the large demands for storage batteries. In that factory the company also manufactures switches, cut-outs and all the accessory appliances requisite for a storage battery installation. The highest state of development has been obtained by this company in the method of manufacturing storage battery. All the crude machinery and laborious details until recently employed by every storage battery manufacturer have been abolished by this company, and in their place quick acting mechanical devices have enabled it to make a large production with the aid of a few hands; so that the storage battery is brought entirely in subjection to reliable mechanical methods of manufacture and handling, and, as a result, is made so cheaply as to be within the reach of every consumer. The company now manufactures batteries for the Pennsylvania Railroad company, the Pullman Palace Car company, the Boston & Albany Railroad company, the Connecticut River Railway company, the Canada Atlantic Railway company, the Intercolonial Railway company, the Waltham Watch company, of Waltham, Mass., besides a number of minor corporations.

The Julien Electric Traction company controls the exclusive right under the Julien patent to railway traction by aid of the Julien system of electric traction. This company obtains its batteries at present from the Julien Electric company, but it makes its own regulators and all other devices used in electric traction except motors. Hitherto its motors, although of the Julien type, have been made by the United States Electric Light company at Newark, but the Julien Electric Traction company intends very soon to make those machines itself. At present the company is devoting almost its exclusive attention to advancing and perfecting its installation of electric cars on Fourth avenue, New York. Three cars are now in actual daily service carrying passengers, and other cars will follow from week to week. Storage battery traction is growing more and more in favor with street railway men every day, as was particularly evinced at the late meeting of the American Street Railway association in Washington, where the address of Mr. Bracken, the president of the Julien Electric company, was received by the members of the association with marked favor.

The new Thomson-Houston electric road at Washington has proved extraordinarily popular. A Washington paper says: Washington has a nine days' wonder in its new electric railroad which runs out to Eckington. Yesterday an immense crowd was gathered all day at the starting point of the road, Seventh street and New York avenue, and during the day over 5,000 passengers were carried. In the early part of the forenoon yesterday only two cars were running, the third car being unavailable. The crowd was then so great that two summer cars were obtained from the Seventh street line of the Washington & Georgetown railroad, and were attached to the motor cars. On these four cars 3,600 pay passengers had been carried up to 8 o'clock last night, and before the road ceased running, between 10 and 11 o'clock, nearly 1,000 more had been added. One train of two cars carried 218 passengers each way. Captain Griffin, who was to have left for Boston yesterday afternoon, remained to watch the working of the road under such a pressure, and was more than gratified at the results accomplished. The board of aldermen of Cambridge, Mass., arrived in Washington Saturday morning to inspect the operation of the road. They were highly pleased with its working in every respect.

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 1.—The suit of the Electrical Accumulator company vs. the Julien Electric company and William Bracken, begun in March, 1887, has reached a final hearing. The suit was brought to establish the validity of the Faure patent of January, 1882, covering the construction of the secondary battery in which the active material, as an oxide of lead, is applied to a plate or support. The familiar device of perforating the lead plates and locating the lead oxide in the perforations embraced in the two patents of Swan, of 1883 and 1885, is also involved. The case was brought in the Southern District court of New York before Judge Coxe, and will probably be closed this week. A vast amount of testimony has been taken. Prof. George W. Barker of Philadelphia, defendant's expert, has made a very complete research, exhibiting the state of the art at the date of the Faure invention. Professor Henry Morton and W. B. Vansize are the complainant's experts. The defense is based upon the fact that an oxide of lead had been used as a depolarizer in a primary battery as early as 1863, and also on the prior experiments of Dr. Vander Weyde and Charles F. Brush. It is expected that a decision will be reached in about a month. Should the Accumulator company prevail, they expect to control the entire field.

At the meeting of the Board of Electrical Control on Tuesday the United States Illuminating company made applications for several permits for overhead wires, some of which were granted, while others were not. On motion of Mr. Gibbens, the secretary was instructed to inform the company that no permits would be granted it in streets where subways had been constructed. The Electric Power company renewed its application for permits through Assemblyman O'Connor, who addressed the board in behalf of the company. He assured the board that the company had the written consent of the United States Illuminating company for the use of its poles, and it was the intention to string the wires for temporary service pending the construction of the subways. Secretary Moss asked to see the written consent of the United States company, which Mr. O'Connor could not produce, but he promised to present it at the next meeting. Ex-Judge Kelly, representing the United States company, challenged his statement, and Mr. O'Connor, after stating that he had no right to interfere in the matter, left the room muttering. Ex-Judge Kelly then went to the telephone, and after conversing with his clients stated that he was entirely correct, and that no such consent had been given to the Electric Power company.

The joint report of Chief Engineer Kearney and Electrical Engineer Wheeler was then read regarding the damage to underground cables by the heat from the pipes of the Steam Heating company. The following is an extract from the report: "The sole cause of the trouble is the heat caused by the escaping steam from the pipes. This brings the temperature of the conduits up to a point which none of the cables, as ordinarily made for underground work, can stand, and it is doubtful if any practical cable can be made which will stand the high temperature, and at the same time be waterproof. All of the substances used as insulation in making waterproof cables are inorganic compounds which either melt or become soft at a high temperature, in which case they both deteriorate as insulators and run or drip off the wires as well, or they become charred or burned, and thus lose their insulating properties, and crumble or drop off the wires. In order to avoid all of these materials which are rendered useless by the heat met with, we decided to inquire into the probable chances of a cable covered with some woven fabric, but left dry; that is, not treated with any fusible substance such as wax or rubber, relying upon a lead pipe covering to keep the water out. We found that precisely such a cable has been laid by the telephone company across Broadway at Ann street, where a high degree of heat was met; but unfortunately this has not been put in use yet, and we were not able to get its results. The telegraph company laid a similar cable about two years ago which gave out, but the cotton had been treated with some substance which may have impaired it, and the lead covering was injured enough to admit water. These are the only two cases we could find of effort having been made to make cables which would stand this heat, but unfortunately neither is a criterion. The remedy is unquestionably with the Steam Heating company in stopping the leaks. The problem of making a cable to stand the heat is one of great difficulty and uncertainty as to the results, if it is possible at all. The heat caused by the steam leakage on Broadway was so great at the time the cable spoken of was laid two years ago that it expanded the brass pneumatic dispatch tubes of the Western Union company, and crushed their ends against the brick junction boxes. A lead covering for cables will carry off some of the heat at first, and in some cases where the heating is temporary or local such a covering will be sufficient protection." A letter from the telephone company accompanied the report, in which it was stated that tests had been made of the new cables running parallel with the steam pipes, and it was found that the insulation had deteriorated considerably since they had been placed in the conduits, owing probably to the extreme heat. Notwithstanding this report the board did not feel justified in granting a permit to the Western Union company for the stringing of five cables overhead, they having asked the privilege on account of the damage to their cables from the steam heat. It is stated that the Conduit company contemplates bringing suit against the Steam company, which, however, is said to be making repairs as rapidly as possible.

Col C. H. Haskins returned last week from Europe, where he had spent a year and a half for the benefit of his health. He looks rosy and strong, and reports himself as being in thoroughly good condition. He has given much attention to the thorough inspection of various electrical enterprises, and states that there is considerable activity in incandescent lighting in England and France.

The franchise recently granted in Brooklyn to the Edison company to lay its wires under the streets of the city has been vetoed by Mayor Chapin, at the request of the company, on account of some defect in the ordinance, which will be remedied by the presentation of a new draft. P.

State of Iowa.

SIOUX CITY, Ia., Nov. 2.—The scheme of building an elevated railway on Third street, over which the Morningside electric motor line was to come into the business part of the city, has been dropped for awhile. The line will come in, however. Arrangements have been about completed whereby the Rapid Transit company will run in on the St. Paul track to a point west of the stock yards, and up into town over the C. M. & St. P. track. B.

Pittsburgh, Pa.

PITTSBURGH, Pa., Nov. 1.—The Philadelphia company recently erected a number of telephone poles on Fisk street, which extends from Butler street to Penn avenue, Lawrenceville, the poles being intended to carry the telephone wires of the company for its line to Murraysville. It had met with some opposition in putting up the poles in the lower part of the city, so when it went to work on Fisk street it concealed its tool wagon in the neighborhood, and at a given signal a large force of men appeared on the street, and worked with such rapidity that in less than an hour the poles were erected on the entire length of the thoroughfare. The property owners protested with the workmen against putting the poles up. The men, it is said, told the indignant property holders that the poles were being put in by the city for the fire alarm wires. With some of the residents this explanation had the desired effect, and they allowed the work to proceed.

On Saturday morning, however, several of the poles were found lying on the street having been cut down. Saturday morning James Campbell, one of the property holders, telephoned to the company's office that he had ordered the poles in front of his property cut down, and notified the company to come and take away its kindling wood. On Saturday night some more of the poles were cut down, and yesterday it was found that several poles on Forty-first street, erected on Friday, had also been cut down.

Captain Ward of Fisk street, was one of the parties who ordered the poles cut down in front of his property. The people on that street say that they have the law on their side, and they will not allow the Philadelphia company to maintain its poles there. They claim that there is a city ordinance in their favor, and they mean to enforce it. About a dozen poles have been cut down already, and more will probably go. The poles were subsequently replaced, as the company came to an understanding with the residents. McD.

San Francisco, Cal.

SAN FRANCISCO, CAL., Oct. 30.—In the annual report of Warden Aull, of the Folsom prison, he says:

"We hope to complete the dam and canal to and beyond the prison by the last of December, 1889, and will by that time be ready to utilize the resultant power for the benefit of the prison. We can then dispense with steam as a motor for pumping the water used at the prison for domestic and irrigating purposes. Sufficient water can be raised, with small outlay for pump and pipe, to irrigate the entire prison tract. With the raising of vegetables, grapes and fruit, the keeping of the prisoners would be materially decreased, and at the same time furnish employment for boys and novices in crime that would be healthful and have the most reformatory influences. With proper dynamos we can generate electric light for the prison and ground, greatly

reducing the chances of escape and giving opportunity to work the convicts by night as well as by day if necessary. The electric power generated from the dynamo can be applied to the quarry derricks and improved machinery for drilling and dressing stone, decreasing the cost of the quarry and stoneyard, while largely increasing the output. When this is done we will not have utilized half the power at our command, and we will be in a position to operate any kind of a factory that may be deemed advisable by the legislature or by your honorable body."

The warden estimates the cost of the electric machinery at $15,280. Other expenses for the improvements bring up the total to $112,500. D.

Dayton, O.

DAYTON, O., Oct. 20.—Josie Durbin, a domestic, 18 years old, got on a White Line electric car at a street crossing the other evening, and when the car was midway in the block fell dead in her seat. The report quickly spread that her death was caused by an electric shock conveyed from the car motor. There was considerable excitement throughout the city in consequence. A medical examination showed that her death was from heart disease. B.

Topeka, Kan.

TOPEKA, Kan., Oct. 19.—The Rapid Transit company has contracted with the Thomson-Houston company for the conversion of its steam motor line to an electric road. Five cars are to be in operation by January 1st, five more by February 1st, and twenty by April 1st. Each car will have two 10 horse power motors. G.

The Inter-State company has its central station storage battery plant in operation now, and is as proud as a young hen that has just laid its first egg.

A.

THE ELECTRIC LIGHT.

The citizens of Mobile, Ala , are demanding additional electric lights.

The Tobey Furniture company of Chicago has recently increased its Van Depoele arc plant.

The Athens, Ga., Gas Light company will at once put in an electric light plant to cost $15,000.

The electric light plant at Grand Ledge, Mich., has been completed, and is now in successful operation.

The Thomson-Houston company of Chicago has sold a thirty light arc plant to S. A. Paddock of Mason, Mich.

The Van Depoele company recently sold a small arc plant to Falkenberg's laundry, Thirty-first street, Chicago.

The capital stock of the Coshocton,, O., Light, Fuel & Power company has been increased from $31,000 to $40,000.

The Chicago Arc Light and Power company recently purchased 160 arc lights of the Thomson-Houston company, Chicago.

The Troy Fertilizer company of Troy, Ala., will rebuild its mill which was recently burned, and will install an electric light plant.

The Oxford Electric Light company of Oxford, O., has been incorporated by Geo. C. Munns and others; capital stock, $20,000.

The Southern Electric company, capital $10,000, of Birmingham, Ala., bas been incorporated by E. G. Stevens, jr., and others.

The Van Depoele company of Chicago has sold 120 double carbon lamps to the Consumers' Electric Light company of Chicago.

The Baxter Springs Light and Power company, of Baxter Springs, Kan , has been incorporated, with a capital stock of $20,000.

The Coldwater, Mich., Electric Light company has ordered of the Western Electric company of Chicago an increase to its present plant.

The Thomson-Houston company, of Chicago, has sold to the Oshkosh, Wis., Electric Light and Power company a 500 light incandescent plant.

The United States Light and Power company, of Portland, Ore., has ordered of the Thomson-Houston company, Chicago, a 50-arc light increase.

Cleveland felicitates itself on the fact that of the 150 tons of carbons consumed daily, 100 tons are turned out in the twenty carbon furnaces of Cleveland.

Jacob Bell of David City, Neb., has purchased of the Thomson-Houston company of Chicago a plant consisting of 30 arc lights and 300 incandescent lamps.

The question of erecting an electric light station is agitated at Atlantic, Ia., and the gas company is trying to head off the movement by reducing the price of gas.

The Western Electric Light & Power company of Toledo, O., has ordered an increase to its present plant of the Western Electric company of Chicago 200 arc lamps.

The Buena Vista Electric Light company, of Buena Vista, Cal., has organized H. H. Daniels, John Tiptore and G. S. wood are directors. The capital stock is $15,500.

The Marshalltown, Iowa, Electric Light and Power company has increased its plant by purchasing 1,000 incandescent lights of the Thomson Houston company, Chicago.

The Calumet & Hecla Mines in Northern Michigan who have been using Brush electric lighting apparatus for some years ve just arranged to increase their electrical plant by ordering through Alexander Kempt, special agent for the Brush Electric company, a new 28 to 30 light dynamo and additional lamps.

The Hyde Park, Ill., Electric Light & Power company has been incorporated. Capital stock $500,000; incorporators, Lester S Hills, Henry Decker and Lewis H. Bisbee.

The St. Paul ice palace this year will be an elaborate structure, and will resemble a mediæval castle. The windows in the tower will be brilliantly illuminated by electric lights.

The Kingman Electric company of Kingman, Kan , is erecting an addition to its building to accommodate another 300 light incandescent dynamo, and two 50 horse power boilers.

Edward W. Tisdall, special agent of the Brush Electric company, has recently sold a 62 to 65 light Brush arc light machine to be used for central station purposes in Philadelphia.

The electric light plant of 500 lights of the rubber company at Colchester, Ct,, furnished by the Edison United Manufacturing company of New York, is giving satisfaction.

The Heisler Electric Light company of St. Louis, Mo., has received an order for a central station plant in Michigan City, Ind., which will be completed and in running order before Christmas.

Another 500 light dynamo has been shipped by the Heisler Electric Light company of St. Louis, Mo., to its Matteawan station on the Hudson River in New York state. This makes the third dynamo for that station.

The Boonville, N. Y., Elec ric Light & Power company has been incorporated. The capital stock is $10,000. The term of existence of the company is fifty years. The following are the trustees for the first year: Milton J. Hoyt, W. B Johnson, F. A. Willard, H. A. Bentley, Charles E. Thompson and A. J. Schweinsberg.

Last Sunday night for the first time the new white lights. composed of twenty-four incandescent electric lamps, each of 30 candle power, were displayed from the inshore water-works crib. The lights are sixty-five feet above the level of the lake, and will hereafter supply a valuable beacon for lake mariners. In foggy weather a signal bell struck by electricity will indicate the location of the crib.

J. Geo. Kaelber, general agent for the Heisler Electric Light company, St. Louis, Mo., has secured a contract for a central station plant at Buena Vista, Col. Poles are now being set and the plant will be completed and in working order in December. The station will combine street and commercial lighting. The circuit will be 8 miles long. The dynamo will be run by water power located about a mile outside the city.

The ordinance granting the privilege of certain streets to the Edison Light & Power company came up on its first reading at the meeting of the St. Paul common council, October 19th. The company propose to put in subways for the use of their electric wires for furnishing light and power. No exclusive franchise was asked This, as well as the ordinance relating to the Northwestern Telephone company, was referred to the special committee on subways.

The Pueblo Gas company at Pueblo, Col., will have its Heisler plant of 2,000 lights in operation in a few weeks. The dynamos have been shipped and the plant is in course of construction. Street, commercial and private house lighting will be furnished. There will be about 15 miles of circuits. The electrical plant is located at the gas works. A railroad switch connects with the works, and coal is delivered in front of the boilers. Armington & Sims and Ball engines are to be used.

That portion of the business of the Julien Electric company which belongs particularly to train service has been taken by a new company, the Railway Electric Lighting & Signal company. The business of car lighting will be pushed forward, and some new applications of electricity will be introduced. An electric train signal is now offered. This is an idea which naturally follows the introduction of electricity on the train for lighting, as the pneumatic train signal followed the use of the air brake.

Edgar G. Jones of Baltimore, Md., representing the Heisler electric light system, was in the city a short time ago, says a Sault Ste Marie paper. He came up for the purpose of submitting a proposition to the Canadian Soo to put in an electric light plant. His proposition was received so favorably that a committee consisting of Mayor Biggings, P. C. Campbell and Thos. Collins was sent to St. Louis and one or two other places, to examine the light at those points, and report to the council the result of its investigation.

An agreement has been entered into by the Hillsboro, Ohio, city council and the gas company, by which the city is to be lighted with electricity, by the Thomson-Houston system. The company propose to furnish 60 lights of 2,000 candle power each, which will illuminate the city, while private consumers will have the choice of either incandescent light or gas. The two systems are to be operated by a 100 horse power engine running the two dynamos. The contract is for five years, at $1,250 per year. The city building is to be lighted free.

William Seafert & Co., of 159 La Salle street, Chicago, Ill , are manufacturing a new dynamo of both the arc and incandescent type. The dynamo is reversible, and may be used as a generator or motor. Much is promised in the way of automatic regulation. A new principle is employed, the simple tilting of a delicately poised lever affecting the entire regulation without loss or waste of energy. Among the claims made are the following: "In this system the current is always so regulated and controlled that energy is never produced beyond the requirement of the external circuit. The generator automatically adjusts itself to any load which the external circuit may be carrying. The brushes always ride at the points of best action, permitting the full strength of current to flow from the armature to points in the circuit where it is required for useful work. The energy required in the external circuit is made the limit of output in the generator"

The question of electric lighting in Medford, Mass. came up before the board of selectmen again last week. By a unanimous vote a contract was closed with the Malden Electric Light company for 200 incandescent lights and twenty arc lights, the latter and forty of the incandescent lights to be furnished immediately, and the remainder of the 200 incandescent lights to be furnished before spring. All the other lighting in town is to be by oil lamps furnished by the same company, and the whole system of lighting to be furnished at the rate of $7,000 per year for a term of three years.

Manager Gifford, of the Louisville Telephone company, is protesting against the electric wires on Green street. He says that the wires have been attached to his poles, and that they interfere materially with his telephone wires, causing a buzzing and roaring in the ear piece which, to a great extent, interferes with the working of the instruments. He adds that, should one of the electric light wires break and fall across a telephone wire, there would be imminent danger of great damage to his system in the way of burning up his instruments, setting the central office on fire, etc., etc. A Louisville paper says the wires will probably be removed.

At a meeting of the Buffalo, N. Y., common council, October 22d, the comptroller stated that he had received from the three local electric light companies bids for electric illumination for the coming year at 45 cents per lamp per night, a reduction of 2½ cents per lamp per night upon last year's prices; and from the three local gas companies bids to furnish the gas for city use at $1.30 per thousand, a reduction of 5 cents per thousand on last year's prices. The bids were referred to the committee on lamps. Petitions were received asking that the electric light and telephone poles on Elmwood avenue, between North street and Forest avenue, be removed.

Sealed proposals will be received at the office of the city clerk of Kalamazoo, Mich., until 2 o'clock P. M., on Friday, Nov. 16, 1888, for furnishing to the city of Kalamazoo a complete electric plant outfit and apparatus for lighting the streets of the city with electricity, including everything necessary for the purpose, except building and ground, which will be provided by the city. The power to be furnished to be 175 horse power, and the capacity of dynamos to be sufficient for 150 arc lamps of 2,000 candle power each; extent of circuit, 35 miles, with 150 double lamps. Bids must beaccompanied with a deposit of $1,000 as a guarantee of the good faith of the bidder.

Prof. E. Wollny of Munich, has experimented on the effect of electric currents of different intensities and characters on the growth of plants. Small plats of about four metres square were provided, and were separated by plates penetratiog twenty-five centimeters into the soil. On the two sides of one of these beds, plates of zinc were sunk, the dimensions being thirty centimeters by two meters They were connected by an insulated wire, with five Meidinger cells in the circuit. Another inclosure had an alternating current constantly sent across it, while in a third there were simply buried a copper and zinc plate connected above the earth by an insulated wire. The three inclosures were therefore subjected to different conditions—to a weak direct current, to a comparatively strong direct current, and to an alternating current. Several specimens of grain, potatoes, carrots, etc., were planted, and were subjected to the action of the currents until they reached maturity. Comparing them with plants grown under ordinary conditions, the result to which Professor Wollny is led is, that electricity, whether under the form of continuous currents of different intensities or of alternating currents, exerts no influence on the vegetation of plants.

An article credited to the *Paper Trade Journal* on the electric light for paper mills is going the rounds of the press. It is reprinted here to show how skillfully the writer sets up men of straw only to knock them down again, and to afford a bit of humorous reading to electricians. We will not discuss the article any further than to state that the first conclusion reached by the writer that it is the quantity of electricity which "ties a man into knots and twists him into sausages" is totally erroneous, as can be easily and practically demonstrated: "Electric lighting is the 'proper caper' for 1888 paper mills, and unless electric light currents are kept where they belong, they will set things on fire. It is not the high pressure electricity which ties a man into knots and twists him into sausages; it is not this quality of electricity which sets the mill on fire. It is the quantity of electricity which does it. If two wires touch each other, and two or three hundred amperes of current turned on, and wires are unable to carry all the current at their points of contact, they get red hot, then white hot, and fuse together or burn entirely up. While the white heat business is going on, any inflammable substance near by is pretty apt to get burned, and if it is wood work of wall, ceiling or floor, the fire department has a call. When an electric light wire gets near enough to a pulley the insulation will be worn off. Perhaps nothing further will happen, but if there be another place somewhere else in the mill, perhaps beyond a dozen lamps, where the wire again touches another pulley, then the electricity, a large part of it, will leave the lamps and go through the pulley, the line of shafting, and through the other pulley to the wire again. Where the wire and the pulley touch heat will be developed. If the current be large enough the wire will be melted at these points and fire will occur, if anything inflammable is within reach. Thus may a fire occur, but I never knew of one to originate in that manner. Two wires coming in direct contact without insulation often cause fire. A defective switch or cut out sometimes gets on fire, but the most common way is for the electric light wires to get into contact with telephone or telegraph wires in two or more places. In this manner fire may occur, and in case arc light circuits are thus tapped the fire may break out in some other mill than the one wherein the wires were crossed

A good deal of system and little nonsense will enable the electric light to be used in all places with perfect safety. There is no known substance which electricity will not burn up, if the conditions are right, and it will not pay to give that agent a chance to play any monkey tricks with our buildings. If steam or water is sent around in pipes, there are plenty of methods by which the doings of steam or water are made visible; but with electricity nobody knows when he "has got it and when he hasn't got it," and care is necessary, or you will get electricity when you don't want it, and fire will get your mill."

THE ELECTRIC MOTOR.

A street railway is to be built at Sterling, Ill. The projectors have not yet decided whether they will employ horses or electric power.

The Van Depoele company of Chicago recently sold to the Rockford Electric Power company another motor. The company is supplying power almost to the extent of its capacity.

The cars for the Sacramento electric road have been shipped from Philadelphia. Three miles and a half of road are in running order. The Sacramento Electric Light company will furnish power to charge the batteries in the cars.

The Sprague Motor company sold last week a 10 horse power motor to the *Iowa State Register*, a 5-horse power to the Western Lithograph company, a 3-horse power to Cheshire Bros., of Des Moines, through their local agent, H. O. Woodruff.

Robert McCulloch, vice-president and general manager of the Benton-Belefontaine line, St. Louis, was interviewed recently on electric motors for street cars. He was said to look upon the system with much favor, and his talk carried with it the inference that he considered it as the coming power.

The Short electric system on the Broadway line, St. Louis, will be given a start December 1st and will continue daily until the 1st of March following; and if by that time its success is proven, it will be put in working order on that line as soon as possible There is some fear, however, that the overhead wire system may not be readily permitted by the city authorities on the streets.

Work on the electric railroad to the Wyatt Park addition to St. Joseph, Mo., is progressing in a manner that is more than satisfactory to the projectors of that enterprise. The power house at Thirty-first and Lafayette streets has been completed, and a large portion of the machinery has been placed in position. More than one-half of the track has been laid, and the calculation now is that the whole of it will be completed by December 1st.

The bridge which connects Omaha and Council Bluffs was opened Oct. 30, and the event was appropriately celebrated. One of the most interesting features was the operation of the Thomson–Houston electric railway, which crosses the bridge The road was successful in every particular, and citizens of both cities are enthusiastic over it. Eighteen cars are operated. One of the directors of the Thomson–Houston electric road at Des Moines was present, and inspected the road carefully. He found it satisfactory in every particular, and says he can hardly wait until his own road is in operation.

E. J. Martin, representing the Sprague Electric Railway & Motor company, who has been here for some time past, left for Chicago last night, says a Decatur, Ill , paper. He has been consulting with Messrs. Roberts, Green, Miller, Park and other gentlemen, with a view of establishing an electric railway in Decatur. It is his intention to return here next week, when he will invite the council and representatives of the press to accompany him to Lafayette and witness the working of the line there. He believes there is ample room here for the improvement, and if the gentlemen with whom he has conversed are indisposed to take hold of the matter, there are plenty of outside capitalists willing to push it.

The New England agents of the Sprague Electric Railway & Motor company in Boston, Blake & Sawyer, have recently installed a Sprague motor for a new and interesting application. The motor, which is 1 horse power, is geared to an apparatus used in massage treatment. The operator, instead of personally rubbing and thumping the patient, now simply guides the operation of the machine, and electricity does the rest. Some time ago the Sprague company installed a half horse power motor for the same purpose, which has been giving very good satisfaction. The application of motors to this work is believed to be original, and whether it opens up a large field for electric motors in the future or not, it is but one more point of the adaptability of the motor to all varieties of work.

Among the new applications of motors which have been made during the past week by the Sprague Electric Railway & Motor company of New York, may be mentioned two, which are quite interesting. One of these is at the Wamsutta mills in New Bedford, Mass., in which the electric motor is run from the isolated Edison plant in use in the mill, and is used for hoisting purposes The other is at the Laurel Lake mills at Fall River, Mass., where a 3 horse power motor, also run from the lighting circuit, is used for operating slashers. The advantages of distributing power electrically in mills are many, and are sure to increase the use of motors as they become more well known among mill owners. The power is brought to the point of use upon a cold, immovable and easily bent wire, which can be extended to points inaccessible to any mechanical connection. The efficiency of transmitting power by this method is quite or greater in most cases than by belts and shafting, and the saving in insurance rates is quite considerable.

A Nebraska City, Neb., correspondent writes. Colonel S. N Stewart, the pontoon bridge builder, has in operation near his bridge a machine which he calls the "river horse." It is very simple, being merely a system of paddles revolving on a shaft, and operated entirely by the current of the river. The one on exhibition is of about three horse power, but the colonel says this can be increased to 300 or 500 horse power, as desired. He has sold a patent on this machine to Austrian parties, and it is now in extensive use on the Danube. His idea is to locate a large electric motor here, and distribute the power over the city wherever it may be needed. He offers the use of his patent to any company for the next two years free if they will locate here. The cost of the machine is less per horse power than an engine would be, and once in operation can be run for absolutely nothing. Colonel Stewart is called a crank by many of the people here, but he has demonstrated by his success that he is a very level-headed one.

Peoria, Ill., wants electric railways, and is jealous because Bloomington will have the better motive power. The Peoria *Journal* says: "The street railways of Bloomington are to have electricity as the motive power. Everything has been arranged, and the new system is to be adopted immediately. Here in Peoria we have been trying to get it adopted, but the common council stands in the way, and will not allow the improvement to be made. It would employ a great many men and necessitate an expenditure of a couple of hundred thousand dollars, most of it for labor, and yet a few members of the common council oppose granting the franchise It is a most foolish and unwise policy. We ought to welcome everything in the shape of an improvement, and especially one that adds to the facility of people getting about. We shall in the end, we suppose, adopt electricity, but it will be only when every other city has it, and when we shall lose all the advantages of the advertisement. If the council had acted properly in the matter, we should now be running our street cars by means of this system."

The East Cleveland Street Car company has expended $150,000 in introducing the electric system. Secretary Everett, when asked if his company expected to ultimately run all its cars by electricity, said: "Just as soon as this system is proved to be a success we will begin making preparations for running our cars right through to the square by electricity, not only on the Euclid and Cedar avenue lines, but on the Garden street route as well. This we hope to accomplish within a year, and I will venture to predict that before five years have elapsed every street car in the country will be run by electricity. The traffic is becoming so great that it is no longer possible to take care of it with horses. There are being used in this city to-day 2,700 street car horses, 700 of which will be killed or rendered useless during the next year. This is cruelty to animals with a vengeance, and I think that out of regard for the poor brutes, if for no other reason, all street car companies will endeavor to adopt the electric motor or some other mechanical arrangement for propelling their cars." The new motor cars, some of which have already arrived from Brooklyn, N. Y., are very elegant in finish and design, being illuminated with incandescent electric lights, and fitted up in most elaborate style. There will be fifteen of them. The company has a large number of men busily engaged upon new cars at its shops in Cleveland, and after this year it is hoped that all the running stock may be built in Cleveland.

A representative of the motor business writes to the WESTERN ELECTRICIAN as follows: "Electric light companies have come to realize that it is for their interest to consider the efficiency of the motors, sold by motor manufacturers to the customers renting power. As several electric light companies have learned by experience, where power is sold at so much per horse power, the efficiency of motors plays a very important part so far as their coal piles are concerned, whether on a 220 volt circuit, it requires 35 amperes or 50 amperes to develop 5 horse power on the pulley of the motor. Two prominent electric light companies selling power, for their own protection now require that motors placed on their circuits shall have a certain efficiency. Therefore we might suggest to the manufacturers of motors that in their zeal to meet and beat competitors in the matter of price, they may lose sight of electrical and mechanical efficiencies to the detriment of their own and their competitors' business, and indirectly the electric light companies' interests. While we should like to see the cost of production reduced, believing that more motors could be sold, yet, as compared with gas, engines and steam engines and boilers, the selling price of electric motors per actual horse power delivered per machine is less, and for that reason in place of reducing prices, we would recommend motor manufacturers to aim at greater perfection of manufacture, and pay more attention to switches and plugs in the installation of machines."

THE TELEPHONE.

The conduits for the telephone wires in the business section of Buffalo have been completed at an expense of $200,000.

At Boston, Oct 24th, the directors of the New England Telegraph & Telephone company declared the regular quarterly dividend of 75 cents per share. The report for the quarter ended September 30th shows gross receipts $288,863, increase of same quarter last year $33,007; expenses $210,070, increase $35,333; net earnings $78,793, decrease $2,326; surplus for the quarter $44,424, decrease $35,540.

The St. Paul Chamber of Commerce has been investigating the telephone rates between Minneapolis and St. Paul At a recent meeting the investigating committee reported that no reduction from the present rate could be looked for. The telephone company represented to the committee that their interurban is only a part of their extra urban business, much of which is unprofitable, and part of which is conducted at a positive loss. They, therefore, maintain that the maintenance of the present rates between the two cities is necessary to offset their losses in other directions, and to make their interurban business as a whole fairly profitable.

THE TELEGRAPH.

A letter has been sent by the direction of the Inter-state Commerce commission to the railroad and telegraph companies affected by the act placing the telegraph lines of the rail oads which received government aid under the control of the commission requiring them to file with the Interstate Commerce commission copies of contracts and certain other information relative to the use of these telegraph lines.

The railway telegraph operators on lines centering at Fargo, D. T., organized, October 20th, a division of the Order of Railway Telegraphers, with fifty charter members and the following officers: Chief telegrapher, W. G. Hunter, Fargo; assistant chief, W. T. Berner, Fargo; secretary and treasurer, W. M. Richmond, Glyndon; senior telegrapher, C. L. Wynn, Fargo; junior, J. J. McGrevy, Haggert; inside sentinel, G. M. Coppersmith, Lestonville; outside sentinel, O J. Mohstertagen, Winnipeg Junction; correspondent, A. F. Sheehan, Fargo; past chief, V. M. Lord, Spiritwood.

The decision rendered by Judge Allyn yesterday in the District court here against the Pacific Postal Telegraph company will lead to the chopping down of the poles, if the Northern Pacific company requires it, unless the Supreme court interferes, says a dispatch from Tacoma, W. T. Judge Allyn dissolved the injunction granted by a former judge of the court in 1886 against the Nortbern Pacific Railroad, restraining them interfering with the Pacific Postal Telegraph company in the construction of its telegraph line along the railroad company's right of way from Balama to Portland. The court, in dismissing the injunction, quoted numerous authorities, and declared that, in accord with well-settled principles applicable to rights of way and titles thereto, and also keeping in view due regard to the rights of the railroad company as declared in the act under consideration, it followed that the bill must be dismissed, and the injunction dissolved.

A New York dispatch says there has lately been invented a new system of synchronism, which, it is claimed, will make it cheaper to telegraph messages than to mail them. Dr. J. Harris Rogers, of Washington, is the inventor, and he claims that the world will be almost revolutionized by its discovery. The new system, Dr. Rogers says, reduces the English alphabet to ten elementary characters. The messages are prepared by means of a machine resembling a typewriter, and manipulated in the same manner with the use of ten keys—one for each character—any message desired can be written. Dr. Rogers for the past four years or more has been at work trying to perfect synchronism. Its application is to make two wheels—one at each end of the line—revolve simultaneously. According to Dr. Rogers over 200 words can be transmitted in a minute by his new system. A test of his new apparatus was held on Tuesday afternoon and a message of seventy-six words sent over in twenty-five seconds and printed on a tape in plain Roman characters. The inventor says that he can by this system make one wire do the work that ten do now by the system in vogue.

Personal Paragraphs.

William R. Rathvon of Denver, Col., was in the city last week.

Professor F. B. Badt, formerly a Chicagoan, is back in the city on a flying visit.

Manager Hill of the Hill Clutch works of Cleveland, O., has been in Chicago for several days.

A. Bournonville, representing A. F. Moore & Co. of Philadelphia, was in Chicago last week.

H. O. Woodruff has been appointed superintendent and L. G. Nilson electrician of the Des Moines Edison Light company.

Captain Thompson and Frank B. Trout, manager of the Woodward Electrical company of Detroit, Mich., were in the city last week.

R. T. McDonald, general manager of the Fort Wayne Jenney Electric Light company, Fort Wayne, Ind., was in Chicago several days last week.

It is announced that the executors of the late Sir William Siemens have placed the preparation of his biography in the hands of Dr. William Pole, who was a personal friend of Sir William and his family. The work will be published shortly in one volume, and will be followed by other volumes, containing reprints of Sir William's most important scientific papers, lectures and addresses.

Miscellaneous Notes.

A lecture on electricity was delivered before the Y. M. C. A of Springfield, O., October 23d, by Mr. Chubbuck of that city. The address proved so instructive that a second address on the same subject will soon be given.

The telegraph, telephone and electric light companies are making arrangements to lay their conduits under ground in Cleveland. The wires will first be placed under the streets, on Superior hill, Water and River. Permits for tearing up the pavements have been issued.

The following story, of which the details were doubtless manufactured by a fertile brain, comes from New Haven, Conn.: When a clerk in Brown's meat and fish market, on Grand avenue, accidentally laid his hand on a big cleaver, he received an electric shock that caused a strong prickling sensation to pass through his system. It was ascertained that through some disarrangement of the electric light wires the store was thoroughly charged with electricity. A crowd quickly gathered, and Mr. Brown, being of a jovial disposition, determined to have some fun. On one of the hooks of the rack back of the meat bench hung the carcass of a lamb. A stout Irishman came in that moment and inquired the price of a shoulder. Mr. Brown offered the whole lamb to him if he would remove it from the hook and carry

it off. Pat put his sturdy shoulder under the carcass, threw his arms around it and tried to lift it. The shock he got nearly threw him to the floor. A basket of oysters stood leaning against the wall and touched a water pipe. A young man came in to buy a peck, and was told to help himself. He lifted one, and dropped it with a howl. A barrel of cabbages was also charged with the electricity. When Mr. Brown told a woman who wanted one that she might have it and welcome, as she was an old customer, she swooped down on the barrel and picked out the nicest head that she could see. She will not touch another if you offer to pay her for it. She set up a screeching and groaning and rushed through the jeering crowd out of sight, and Mr. Brown sadly contemplated the fact that he had lost her trade. Just at this time a lineman came along and soon found out where the trouble was. It took him a few minutes only to repair the wire, and business was resumed. Mr. Brown says it was the biggest night's trade he ever had.

Business Mention.

The Central Electric company report that orders are raining in upon them.

The Sioux City Foundry and Machine Works have obtained the contract for furnishing the engine for driving the printing machinery in the new *Pioneer-Press* building, St. Paul.

The Holland & Thompson Manufacturing company of St. Paul, Minn., are starting the manufacture of dynamos, electric motors and arc lamps. It is said tests indicate that the machines have high efficiency.

Edw. P. Allis & Co. of Milwaukee, Wis., will be prepared to distribute their 1889 calendar the latter part of this month. The circulation is gratuitous, but is limited to those who make application for it. Consequently those who wish the calendar should send their address to Edw. P. Allis & Co.

F. E. Degenhardt, Chicago manager of the Standard Underground Cable company of Pittsburgh, Pa., reports the sale of 5,000 feet of 100 wire aerial cable, number 20 wire, to the Cleveland, O., Telephone company, and 9,500 feet of cable, number 18 wire, to the Central Union Telephone company for Des Moines, Ia. With this order go 9,000 one piece hangers. A still larger order is given by the city of Chicago for five miles of electric light cable equipped with the Acbeson protective device.

The appended mechanical fable, said to be founded on fact, is unique as well as interesting:

A Yankee Woodchuck was in the hollow wooden ware business in opposition to a Canadian Wolf. The Woodchuck imported Canadian lumber and exported butter bowls, underselling the Wolf in the Canadian market. Tiring of this, the Wolf sent a spy to the Woodchuck's factory and received a glowing account of the wonderful, fast, light-running machinery, which whisked out a dozen bowls to the Canadian Mill's one. After months of conservative deliberation, the Wolf, concluding not to be beaten, went down to the metropolis for a model plant. After learning much of the standard practice, and finding what he supposed was needed, he purchased an outfit which turned out his product at a much reduced cost, but still the Woodchuck was underselling him in the Canadian market. After much thought, another visit to the Yankee mill not only revealed the fact that the Woodchuck had refitted with new machinery throughout, but that the Wolf had purchased the Woodchuck's second-hand plant.

MORAL: If you cannot afford to buy a Westinghouse compound engine, your competitors can.

The Sioux City Foundry & Machine works of Sioux City, Ia., since its incorporation in 1884, when additional facilities and improvements were introduced, has been doing a large and growing business. The works are among the best equipped in the northwest, and for years the company has been supplying to a large extent of territory tributary to Sioux City. It has been the aim of the management to increase in every way possible the efficiency of every department, and during the past six months additional improvements have been made in the machinery and equipments in the different departments. The company has now one of the best equipped pattern shops in the west, all of the tools being new and of the most improved design. It has also equipped a large drawing room and a large salesroom for the display of the goods of its own manufacture, also those for it they is the general western agent. Extensive improvements have been made in both boiler shop and machine shop by the addition of new and heavy machinery specially adapted to the line of work the company has seected as a specialty, viz., the building of high grade automatic engines of both the Corliss and single valve type, it having been deemed wise to discontinue the building of the ordinary slide valve and cheaper grades of engines, simply handling them for eastern builders, and confining its attention and directing all its facilities to the production of a high class of goods, feeling that it was impossible to combine both the high grade and the cheaper grade of engines in the same works. It is the intention to make the boiler shop one of the largest and best equipped in the west, and to turn out work second to none in the country; at the same time declining to compete with the cheaper grades of eastern work which are offered at such extremely low prices as to make it impossible to furnish first-class goods. The company is now erecting in its machine shop a large overhead traveling crane of about three tons' capacity, which will furnish the best facilities for handling heavy work in and out of the larger machine tools, and for putting up and taking down engines; also for loading the engines complete for shipment. In addition to the manufacture of high grade automatic engines, the company is now handling a full line of engines built by the Erie Engine works, Cleveland & Hardwicke, proprietors. The company is general western agent for the Miller duplex steam pumps, especially adapted to boiler feeding; also western agent for the Shipman oil engines. It also carries in its salesroom a stock of belting, packing, brass goods and steam and mill supplies, generally being able to fill all orders for the same on short notice. While much of the time during the past summer has been spent in improving the works and putting them in shape suited to its special business, the company has in addition furnished a large number of outfits for driving grain elevators, electric lighting plants and flouring mills, and is prepared at any time to furnish bids on such specifications as may be submitted for the complete equipment of motive power plants from one to 500 horse power; also steam boiler plants alone of any size or capacity for waterworks stations and the like It has recently issued some new printed matter descriptive of the new goods it manufactures and handles, which will be sent on application.

Telephone Stock Quotations.

Chicago	338	340
Central Union	47	48
Michigan	81	82
Great Southern	34	37
Colorado	43	46
Rocky Mountain Bell	41	43
Cumberland	68	70
Wisconsin	116	118
Bell of Missouri	150	155
Iowa Union	28	29
Missouri and Kansas	70	71

Chicago was visited by a storm of unusual violence, October 18th. Lightning struck in several places, but occasioned but little damage.

Electrical Patents.

Issued October 30, 1888.

391,783. Automatic Electric Heat Regulator. William A. Connelly, Boston, Mass

391,792. Electric Railway. Isaac W Heysinger, Philadelphia, Pa.

The invention relates to crossing one electric railway with another at full speed, and to the construction of the electric conducting leads, and the supports therefor. There are twenty three claims.

391,793. Motor Car for Electric Railways. Isaac W. Heysinger, Philadelphia, Pa.

The invention consists more especially in the manner of applying the motive power of the motor dynamo to the traction wheel of a motor car.

391,797. Electric Motor. Walter E. Hyer, Newburg, N Y.

391,815. Manufacture of Incandescent Lamp Filaments James W. Packard, New York, N. Y.

391,816 Flashing Apparatus for Carbon Filaments. James W. Packard, New York, N. Y.

The apparatus includes the vacuum chamber, a circuit containing the carbon strip and a circuit breaker in said circuit, controlled by a quantity of mercury and a tube which has one end emersed in the mercury and the other end opening into the vacuum chamber arranged to automatically control the flow of vapor or fluid into said chamber from which the air is being exhausted

391,820 Method of and Apparatus for Dissipating Electricity in Delivering Sheets from Printing Machines. William C. Rossney, Hyde Park, and Charles L. Hunt, Boston, Mass.

391,839 Individual Signaling Apparatus for Telephones. Edward Davis, Boston, Mass.

The first claim reads: "1. A circuit wheel constantly urged by mechanical means to revolve in the same direction, in combination with an electrically actuated escapment, whereby it is controlled during a fractional part of a revolution, and another escapement operated by said wheel, whereby its motion is governed as to speed during the remainder of its revolution."

391,853. Cut-Out for Electric Circuits. Henry C. McDill, Fort Worth, Tex.

391,855. Circuit Closing Mechanism, Charles E. Ongley, New York, N. Y.

391,917 Detachable Circuit Closing Device for Electric Bells and Annunciators. James D. Randall, Memphis, Tenn.

391,923. System and Apparatus for Electrical Distribution. Marmaduke M. M. Slattery, Woburn, Mass.

The invention consists in a system of electric distribution at low tension from a circuit of higher tension of substantially constant current, so as to allow of economy of wiring and flexibility of distribution and manipulation of the light or energy delivered; and it consists mainly in a disposition and arrangement of the circuits with reference to and in combination with apparatus or means for regulating and protecting the devices for utilizing the current. It comprises as its chief features a number of multiple branch circuits, each containing a translating device or devices, such multiples or groups being operated in series, a number of resistance multiple branch circuits, also in series, but in parallel arc with said multiples of translating devices, and conductors between said multiples, together with mechanism for protecting said multiples or groups from injury by reason of undue access of current thereto, and also for varying, if desired, the quantity of current supplied to said translating devices. The fourth claim is as follows: "The herein described means for varying the degree of incandescence of incandescent lamps operated in a series of multiples, consisting in a second series of multiples in a parallel arc with the lamp multiples, each branch thereof containing a suitable resistance, and a manual switch in series with said resistance circuits for opening and closing same at will."

391,943. Electric Switch or Cut-Out. Waldo C. Bryant, Waterbury, Conn.

391,954. Regulator for Dynamo Electric Machines. Stephen D. Field, Yonkers, N. Y.

The object of the invention is to provide a sensitive automatic visual indicator, which will at all times show whether the brushes are at the position of least spark or away from it and, if the latter, will show the direction of movement required to restore them, and the distance to be moved.

The invention is more particularly intended for application to electric locomotives and cars, where an attendant is always present, and will have the indicator constantly in view, and the adjusting lever under his his hand ready for instant manipulation in response to the condition of actual performance,

The fifth claim reads as follows: "In a dynamo electric machine or electric motor, the combination of the armature, the brushes, a movable holder therefor, a pole changing switch mechanically connected to said brush holder, and having a range of adjusting motion in each direction, and an electrical indicating device connected by one terminal with one or both said brushes, and by the other terminal with an intermediate point of the commutator, whereby the brushes may be adjusted in either position by the switch lever without preventing the operation of the indicating device."

391,969 Electric Self Winding Clock. Vitalis Himmer, New York, N Y.

392,018. Electrical Measuring Instrument. Victor R. Emerson, New York, N. Y.

The invention consists in the combination, with a magnetic needle or its equivalent, of two coils or conductors arranged to act oppositely upon said needle, so as to tend to turn the same in opposite directions, and proper mechanism for changing the relative position of either or both of the coils to the needle, so as to permit a balance of inductive actions to be established when different currents are flowing in said coils.

Claim six reads. "The combination, with the needle, of the two coils arranged to act upon the same oppositely, and each mounted upon a suitable support, whereby its distance from the needle may be increased."

392,033. Telephony. William W. Jacques, Newton, Mass.

The invention relates to the use of a metallic or double wire main circuit, the two wires of which constitute the direct and return wires for telephonic utilization, and an earth branch at both ends, with which the telegraph sending and receiving instruments are connected. The telephonic organization thus as a whole comprehends receiving and transmitting instruments at each station included in the metallic circuit while the telegraphic organization as a whole included the two wires of the metallic circuit, the attached earth branch at both ends, and the telegraphic instruments included in the earth branches.

The first claim is given: "In a system of simultaneous telephony and telegraphy, a metallic circuit including telephonic instruments, provided at its ends with earth branches including telegraphic sending and receiving instruments, and a Muirhead condenser"

392,034. Electrical Switch. Orville B. Johnson, St. Johnsbury, Vt.

392,080. Electrode for Secondary Batteries. George H, Stout, New York, N. Y.

392,090 Electric Distribution by Alternating Currents. Carl Zipernowsky, Buda-Pesth, Maximilian Deri, Vienna, and Otto T. Blathy, Buda-Pesth, Austria-Hungary.

The system comprises the combination of induction coils with the conductors, one bobbin of which coils is inserted in the main line of conductors. while the other bobbin is inserted in the circuit supplying translating devices and is closed on a suitable resistance. the current through said supply circuit passing through the resistance and the second bobbin of the induction coil. In this manner the tension of the alternating currents is regulated.

392,103. Electric conductor. Henry F. Campbell, Concord, N. H.

392,114 Apparatus for Electrical Distribution. George B. Fraley, San Francisco, Cal.

392,127 Insulator for Electrical Conductors. John C. Love, Philadelphia, Pa. The invention is especially designed for mounting electrical conductors in conduits for electrical railways and relates to the means for insulating the line conductors. The ninth claim is: "The combination of a conduit, an insulating block having an opening through it, and a support for the block with an electrical conductor having a tongue to secure it in the block, the said tongue being provided with a pin to connect it electrically to the conduit '

392,158. Method of Connecting Filaments to Leading-in Wires Hermann Lemp, Lynn, Mass. The method claimed consists in placing the body to be connected in proximity to the filament and then depositing carbon upon the said filament until it engages the second body.

392,159. Apparatus for Mounting Filaments of Incandescent Lamps. Hermann Lemp, Lynn, Mass. The machine is intended to be used in making the joint between the ends of the carbon filament and the leading-in wire by deposition of carbon at the joint.

392,163. Incandescent. Eugene Moreau, Philadelphia, Pa. Filed Feb. 20, 1888.

391,167. Automatic Electric Switch. Isaiah L. Roberts, Brooklyn, N. Y.

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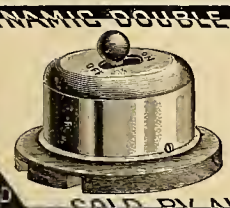

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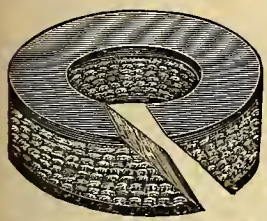

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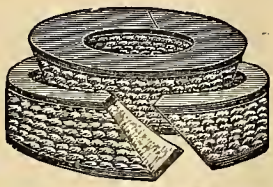

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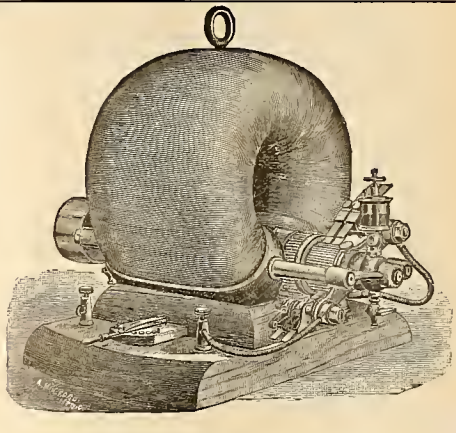

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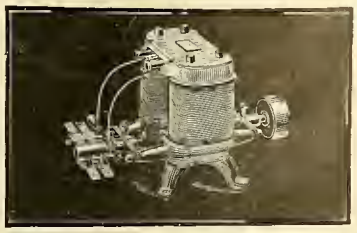

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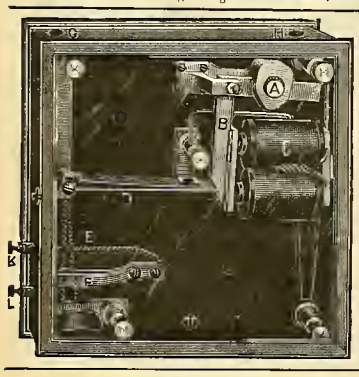

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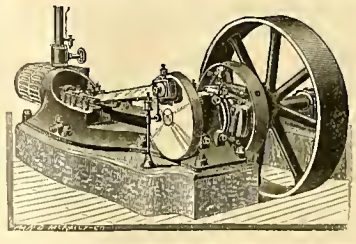

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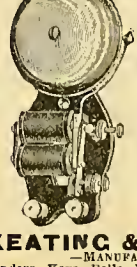

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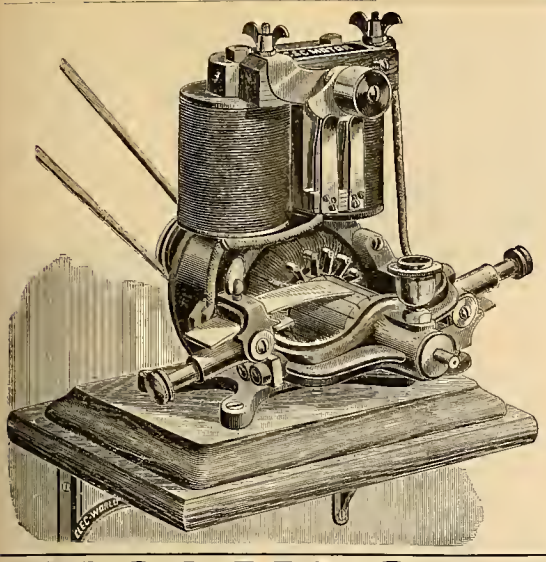

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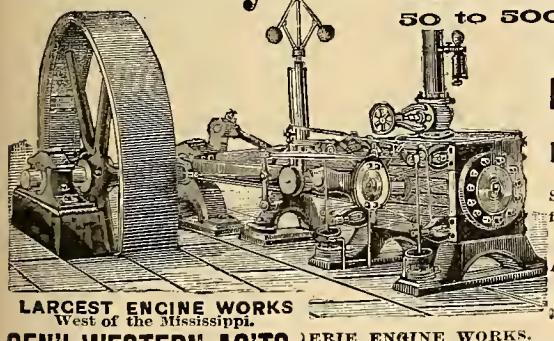

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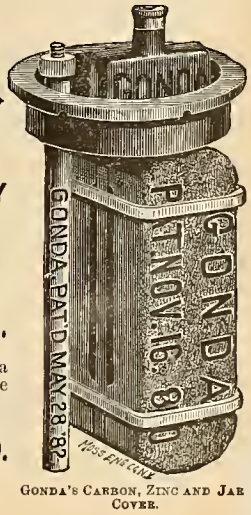

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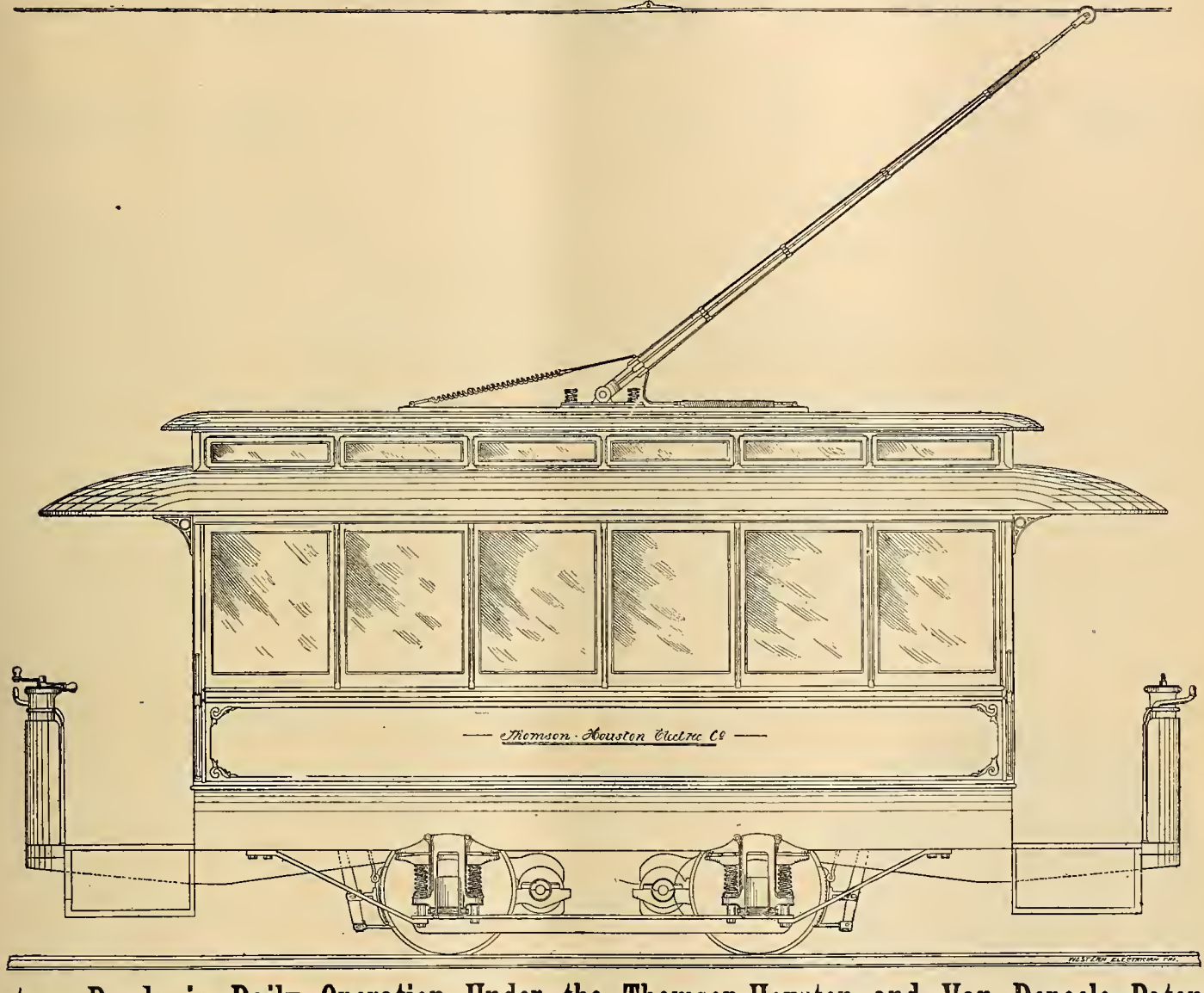

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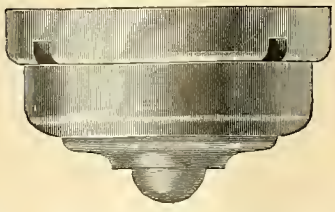

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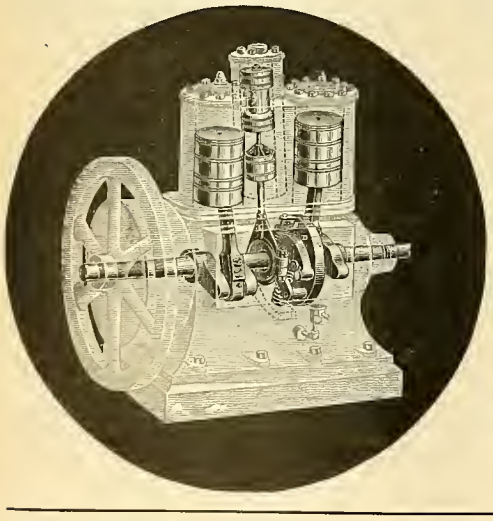

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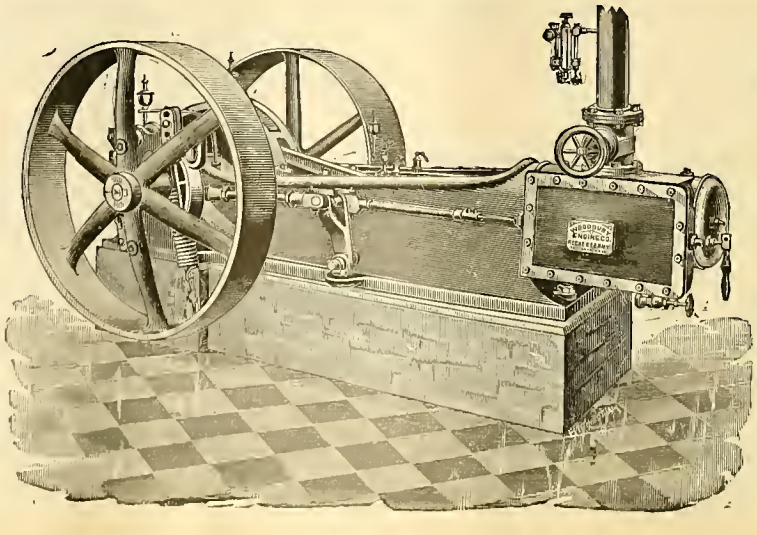

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TABLE OF CONTENTS.

	PAGE.
ELEMENTARY DATA—	
The Electric Current, Chapter I	1, 2
Ohm's Law, Chapter II	2
Work, Chapter III	2
Conductors and Insulators, Chapter IV	2
Direction of the Current, Chapter V	3, 4
Detector Galvanometer and Magneto Bell, Chapter VI	5, 6, 7
ARRANGEMENT OF POWER—	
The Dynamo Room, Chapter VII	8
Motive Power, Chapter VIII	8
Shafting and Pulleys, Chapter IX	9
Foundations for Dynamos, Chapter X	9, 10
Belts, Chapter XI	10
DYNAMO ELECTRIC MACHINES—	
Description of the Dynamo, Chapter XII	11
The Continuous Current Dynamo, Chapter XIII	11, 12, 13, 14
The Series Dynamo	11, 12
The Shunt or Derived Circuit Dynamo	12, 13
The Compound Dynamo	13, 14
The Alternating Current Dynamo, Chapter XIV	14, 15
Preparation of a New Dynamo for Operation, Chapter XV	15, 16
Starting a New Dynamo, Chapter XVI	16
Keeping a Dynamo in Good Order, Chapter XVII	12
Brushes, Chapter XVIII	17, 18, 90
The Commutator, Chapter XIX	19, 17
Repairs, Chapter XX	20, 21
To the Armature	20, 21
To the Field Magnets	21
Testing the Wire Coils of a Dynamo for Contact Against Iron, Chapter XXI	21, 22, 23, 24
DISEASES OF DYNAMOS—	
Non-generation of Current by the Dynamo, Chapter XXII	25, 26
Excessive Sparking of Commutator and Brushes, Chapter XXIII	26, 27
LAMPS—	
Arc Lamps, Chapter XXIV	28, 29, 30, 31
Suspension of Arc Lamps, Chapter XXV	31
Trimming and Cleaning Arc Lamps, Chapter XXVI	32
Incandescent or Glow Lamps, Chapter XXVII	32, 33
Multiple Arc System, Chapter XXVIII	33
Multiple Series System, Chapter XXIX	33, 34, 35
Series Multiple System, Chapter XXX	36
Arc and Incandescent Lamps on the Same Circuit, Chapter XXXI	36, 37 38
The Alternating System, Chapter XXXII	38
INSTRUMENTS—	
Current Indicator or Ampere Meter, Chapter XXXIII	39
Pressure or Potential Indicator, or Voltmeter, Chapter XXXIV	39, 40
Current Regulator, Chapter XXXV	40, 41
Switches, Chapter XXXVI	41, 42
Safety Devices, Chapter XXXVII	42, 43
Lightning Arresters, Chapter XXXVIII	43, 44
Ground Detector, Chapter XXXIX	45, 46
Switch-Board, Chapter XL	46, 47
CIRCUITS OR LEADS—	
Outdoor Leads for Arc Lighting, Chapter XLI	48, 49, 50, 51, 52, 53
Outdoor Leads for Incandescent Lighting, Chapter XLII	53, 54
Arc Circuits Inside of Houses, Chapter XLIII	54
Incandescent Circuits Inside of Houses, Chapter XLIV	55, 56, 57
Size of Wires for Incandescent Lamp Installations, Chapter XLV	57, 58, 70
Testing, Chapter XLVI	58
ACCUMULATORS—	
Accumulators, Chapter XLVII	59
SAFETY REGULATIONS—	
Rules of the Boston Underwriters' Union	60, 61, 62, 63, 64. 65, 66
English Regulations	66, 67, 68
Abstract of the Chicago Electric Light Laws	68, 69
Table of Electric Light Conductors	70
Lamp Lighting Schedule—Moonlight System	71-82
Construction Tools	83-89

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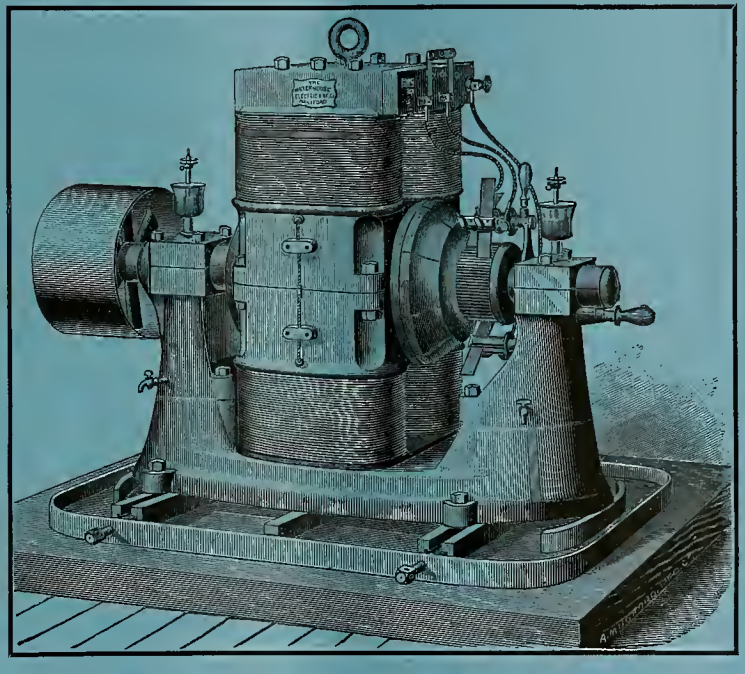

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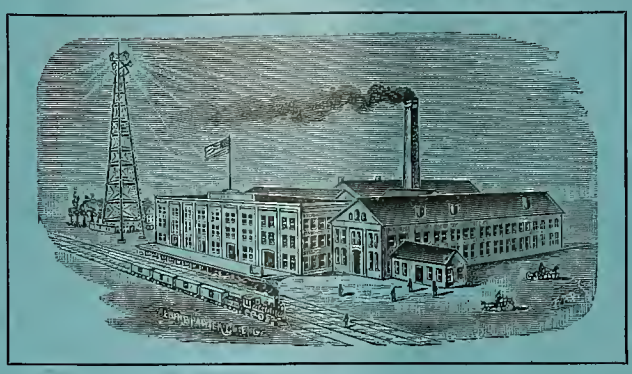

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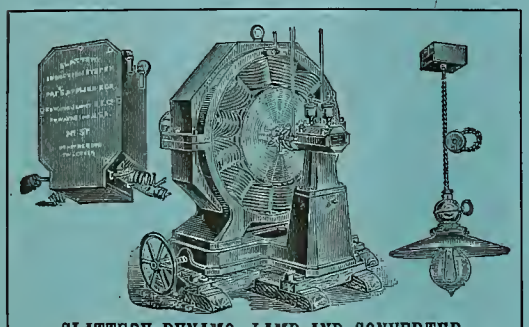

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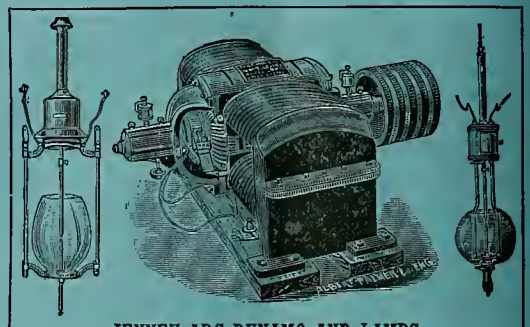

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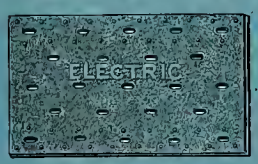

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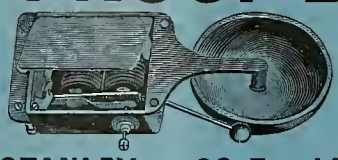
Superior to  All Others.

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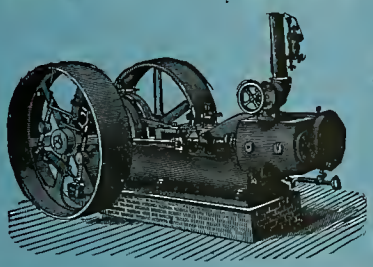

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And other duty requiring close regulation of speed.

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A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

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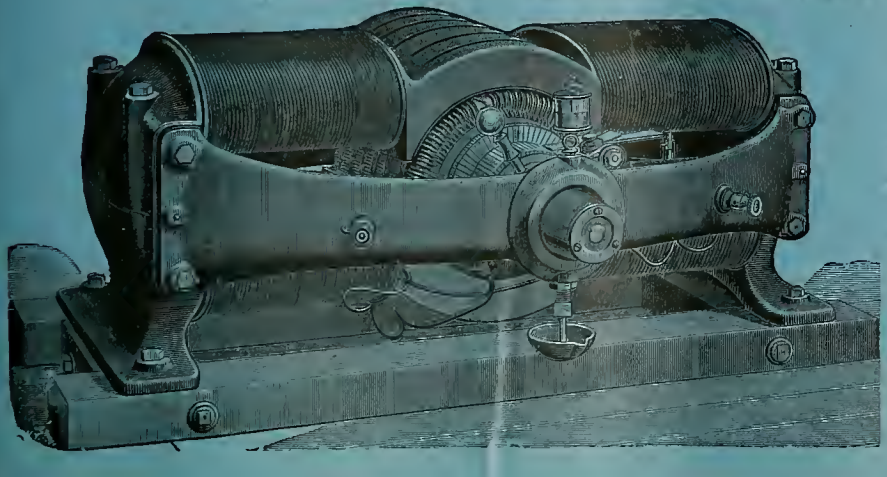

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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

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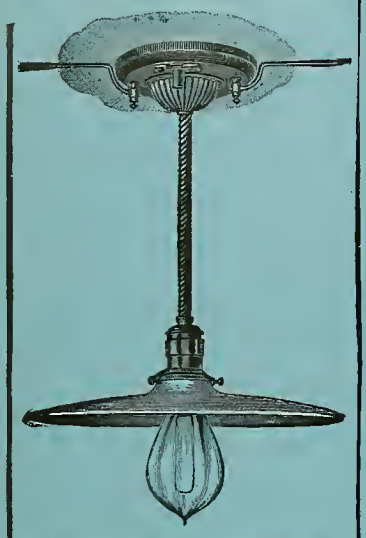

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These Lamps have repeatedly shown their superiority under test.

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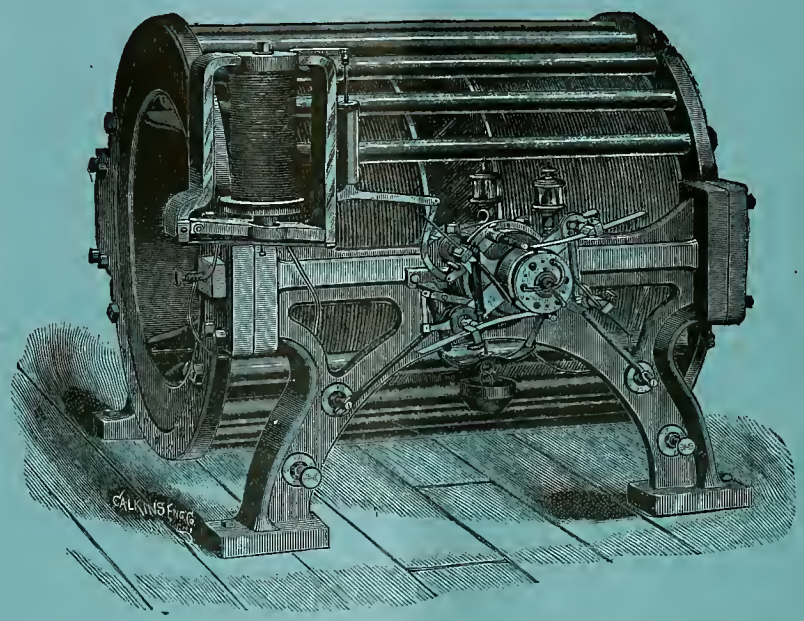
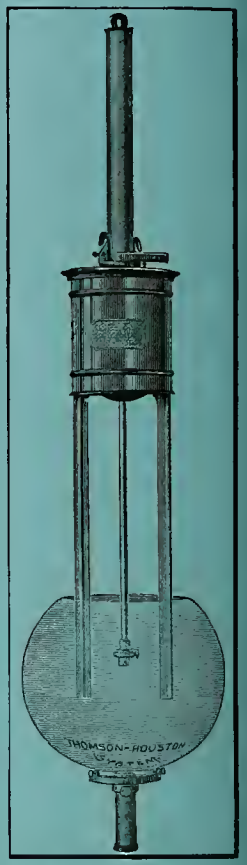


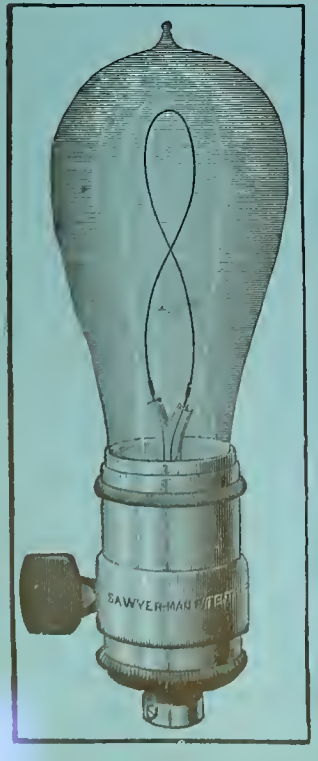


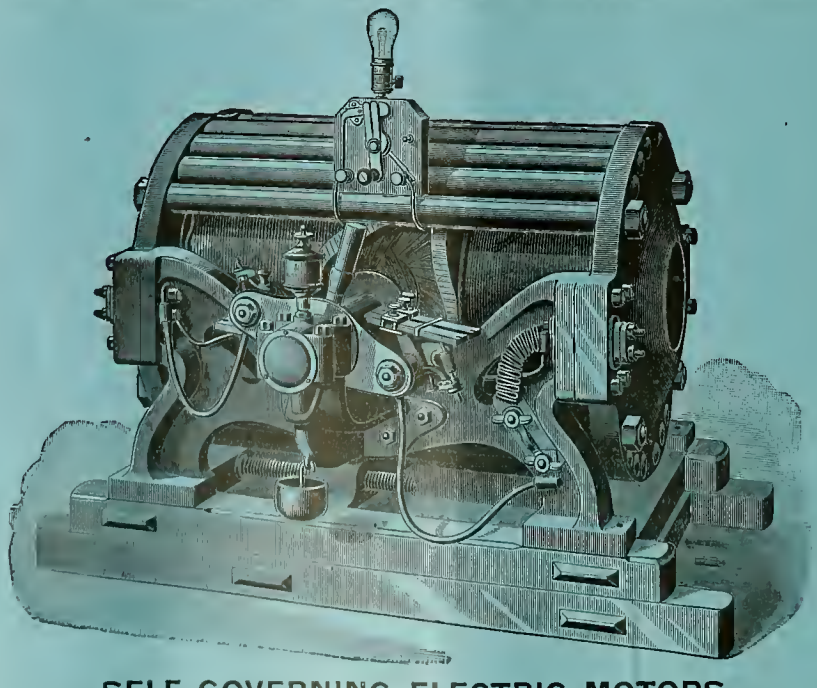
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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all sizes, for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

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The Edison Direct System of Central Station

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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

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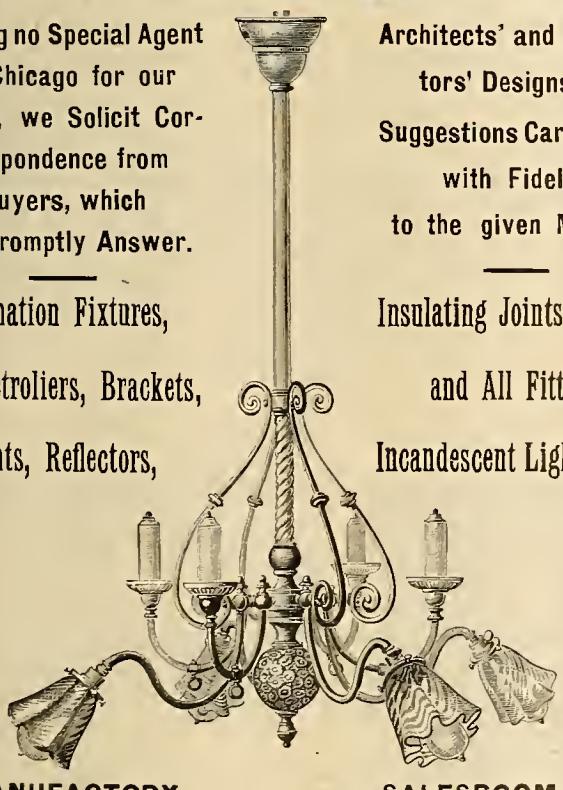

Combination Fixtures, Electroliers, Brackets, Pendants, Reflectors,

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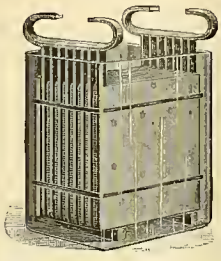

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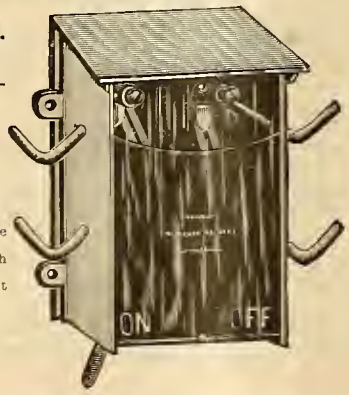
Quick Make and Break Uncontrolled by the Handle.



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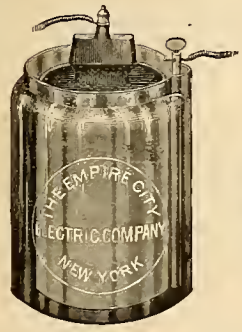

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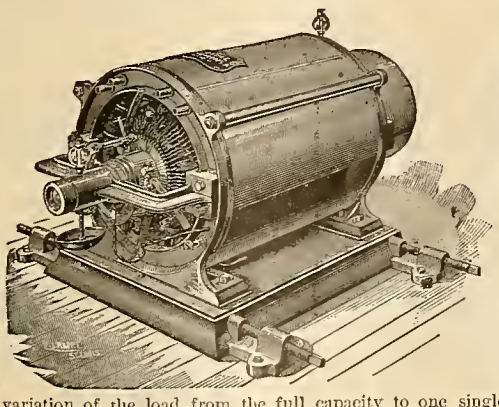

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Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

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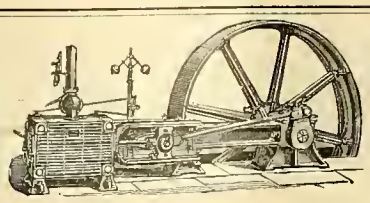

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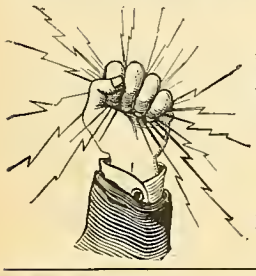

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For hot air, hot water (boiling prevented), natural gas and steam in all forms.
Automatic Electric Valves for Radiator service and Whistle Blowing.
Devices all simple, practical, powerful, ornamental, easily applied, automatic direct acting, inexpensive to maintain, no clockwork or other indirect complications.
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This Company's Meter measures the whole current by a positive mechanical movement.

It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

ALTERNATING CURRENT MOTORS.

Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

Small Motors for use on existing Alternating Circuits of this Company.

ELECTRIC ARC LIGHTING APPARATUS.

PATTERSON CABLES

FOR

Telephone, Telegraph and Electric Light Use.

INSULATED WIRES

OF ALL KINDS.

Testing Apparatus. Telegraph Apparatus. Batteries.
Construction Tools. Line Wire and Supplies.
District Telegraph, Police and Fire Alarm Apparatus.

The Best of Everything at Bottom Prices

Catalogues Furnished on Application.

Send for our latest Catalogue of Electric Bells, Annunciators, Push Buttons, Gas Lighting and Fire Alarm Apparatus, Etc.

WESTERN ELECTRIC CO.,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, NOVEMBER 17, 1888. No. 20.

Warner Electric Time System.

The maintenance of uniform and correct time throughout public buildings, manufactories, schools, railroad stations and other places is a matter of great importance, and frequently one of economy. In no way can a series of time-pieces be regulated so easily, so thoroughly, and so economically as by the electric time system, which consists essentially of a single regulator, or clock, which governs the movements of all the other clocks in circuit with it. The system shown in the accompanying illustrations is that devised by C. D. Warner, and handled in the west by G. A. Harmount, western agent of the New Haven Clock company, Chicago.

The main regulators are shown in different styles in Figs. 1 and 2. These regulators are made to note time as accurately as possible, and through the medium of the electric circuit, in connection with this regulator, all the clocks within the circuit act in unison with it; consequently, any variation from true time noted in the regulator can be corrected, and the act of correction corrects all the other clocks electrically connected with the regulator.

The synchronizing system is in the same case with the regulator, and consists of a circuit closer combined with the regulator movement; an electric gauge, which shows the condition of the electric current sent to the secondary dials; an indicator clock, which shows the time indicated by the secondary dials, and an alarm attachment, which rings a bell in case of interruption of the circuit every minute until attended to. A key is also provided in the regulator for setting the secondary clocks from that point when required. The batteries used with this system are of special design, and will require no care oftener than from twelve to eighteen months; their condition may always be known by a glance at the electric gauge, but if this is not noticed the alarm bell will call attention to it some time before the clocks are affected, should the battery become low.

FIG. 1.

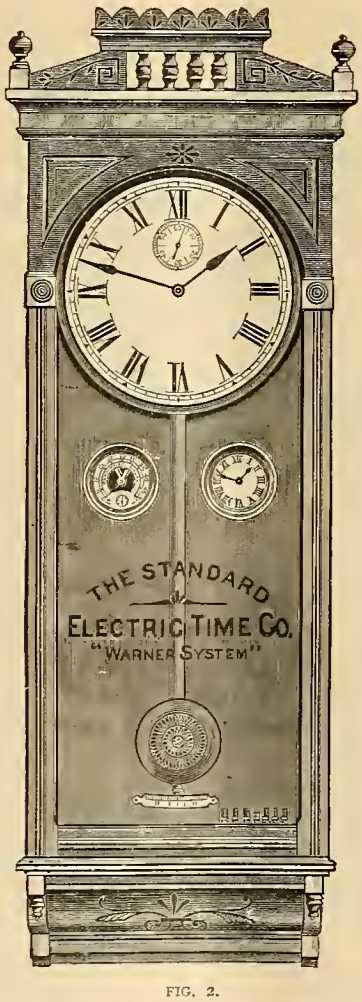


FIG. 2.

FIG. 3.

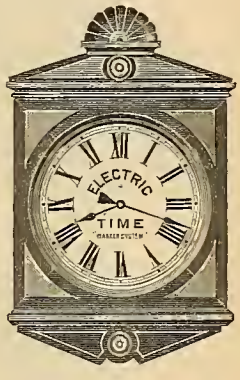


FIG. 4.

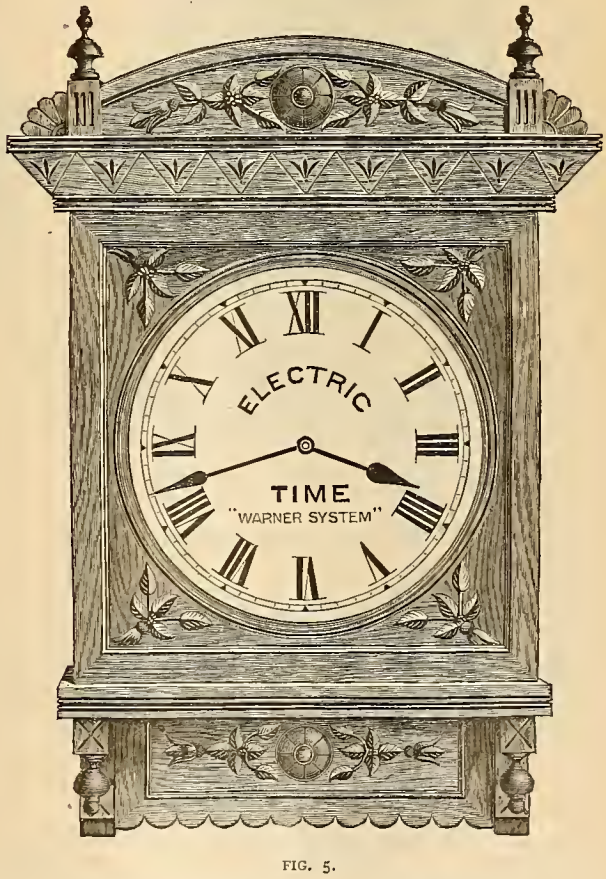


FIG. 5.

The styles of clocks that may be connected in circuit are of course without limit. Figs. 3, 4, 5 and 6 show a range from a common wooden case to a marble case.

Fig. 7 shows the central office switch-board used where a number of circuits are controlled from one central station. The small clocks indicate the time on the various circuits, and the electric gauge in the center indicates the strength of the current on any circuit to which it may be

connected. Fig. 8 shows a view of the gauge. This is also made in the pocket form, shown in Fig. 9, but for use in other ways.

Motor for Pumping an Organ.

The Baxter Motor company, W. W. Munroe, Chicago manager of the western department, has installed in the Augustana college, at Moline, Ill., a motor for pumping an organ. The motor is supplied with current from an arc circuit. The peculiar feature of the installation is the automatic attachment for controlling the motor, starting it and stopping it as occasion may require. The arrangement is simple and consists of a cable or cord, which is attached to that part of the bellows which rises and falls. The cord is guided to the switch of the motor, to which it is attached, and continues on to a spring. The spring is so adjusted that as the bellows fill with air the weight attached to the end of the cord will close the switch. As the bellows are emptied of air the weight on the bellows causes the cord to draw in the opposite direction, and the switch is opened.

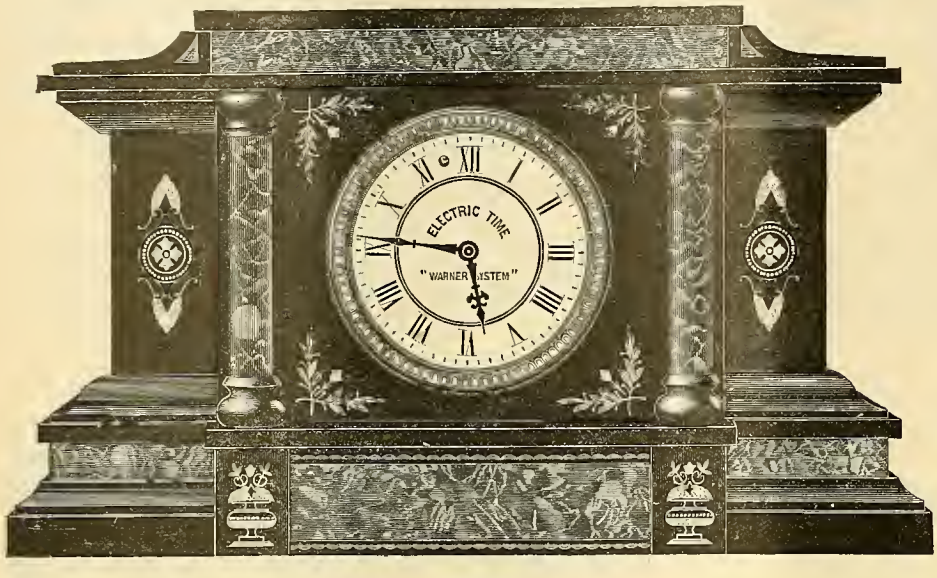


FIG. 6.

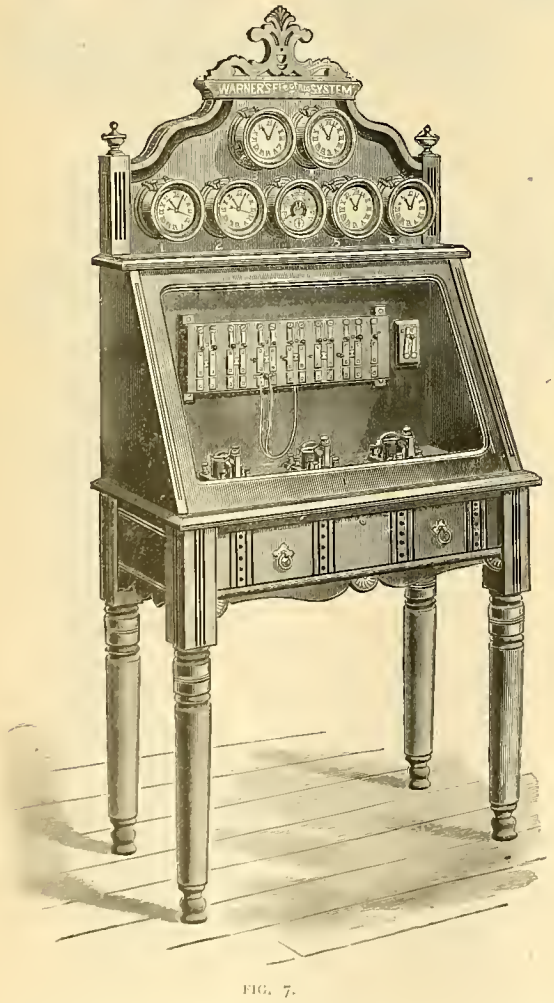


FIG. 7.

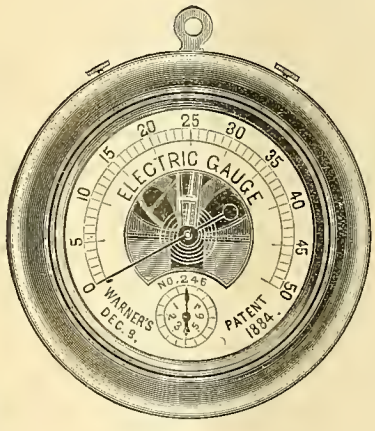


FIG. 8.

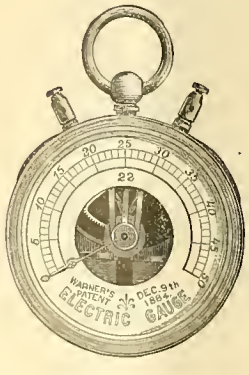


FIG. 9.

Westinghouse Acquires the Waterhouse.

George Westinghouse, jr., has recently acquired the entire capital stock of the Waterhouse Electric & Manufacturing company, and in addition to securing the Waterhouse inventions has acquired possession of other valuable inventions relating to the automatic regulation of current for arc lighting purposes. The machinery for the manufacture of the arc apparatus of the Waterhouse company is being erected in the works of the Westinghouse Electric company in Pittsburgh, Pa., and preparations are being made for the manufacture of arc apparatus on an extensive scale. The Waterhouse company has about 5,000 arc lights in operation and a number of important stations.

Extension Foot Push and Clamp.

A modification of the floor key is shown in Fig. 1 of the accompanying cuts. It is designed by Partrick & Carter of Philadelphia. The purpose is evident. The floor key can be used either with or without the extension attachment. The cord can be attached to a push button which can be held in the lap or by the clamp attachment shown in Fig. 2. This clamp can be quickly put in position on top or underneath a table, desk or other movable furniture, and will not deface it. The combination of the floor key and the clamp makes a most complete dining table attachment.

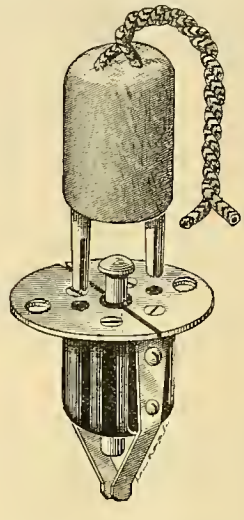


FIG. 1.

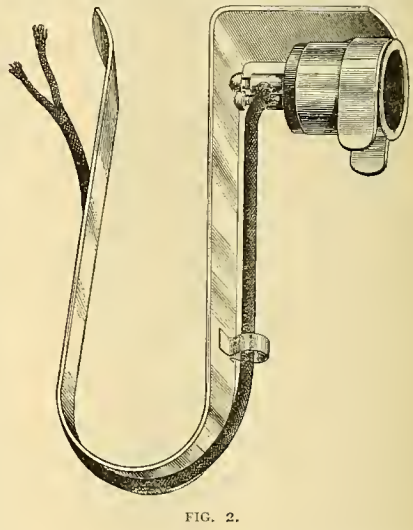


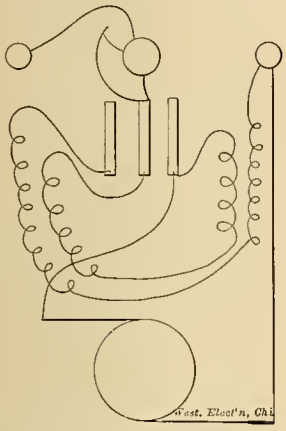
FIG. 2.

The Union Electric Telegraph company is without a superintendent or manager, says a San Francisco paper. It is also without pupils. It is in the hands of the sheriff. Some notoriety was given the concern because of its connection with the Globe Business college. The Union Electric Telegraph company promised to do great things for pupils who paid over $40 for three months' tuition. At the end of that time the student would be an expert in telegraphy, and would be in a position paying from $65 to $100 a month, and would consequently be in condition to bid defiance to fate. Oscar F. Armstrong was the superintendent. It will be remembered that he was arrested, charged with obtaining money by false pretenses some time ago. A motion was made to dismiss the charge, and Judge Lawler granted it. An appeal was taken to the Superior court, where the case is now pending. Oscar still remained at the head of the institution, having for assistant Miss May Muller, who came from the east. They acted for E. Bailey, who conducts the business from the solitudes of St. Louis. Oscar was a pupil, a bright boy, and saw the company was not just doing what it should. It is said he was made superintendent to say nothing about it. Others of the pupils saw how things were being conducted and determined to get back their money, as they were receiving no benefit from the school. They assigned their claims to George W. H. C. Howe, and he brought suit against the company for the money paid in. An attachment for $269 was sworn out yesterday, and the case will be heard before Justice Stafford Saturday. When the sheriff went to serve the papers it was found that Oscar and Miss Muller had disappeared. They have gone east.

Chicago Electric Lighthouse.

Half a mile northeast of the North Side pumping station, in the lake, at Chicago, there has recently been erected on the new crib of the waterworks a lighthouse, first of any on the lakes to bear an electric light. The lighthouse is of skeleton construction, 70 feet in height, and is surmounted by a circular glass lantern; the lighting apparatus itself consists of 24 thirty-two candle power lamps mounted in a circular reflector, composed of silvered glass, and the light given is equal to that of a lighthouse of the second order, and can be readily seen at a distance of eight miles.

Another even more novel application of the electric current is the apparatus for striking the fog bell, illustrations of which are presented. The bell, of 600 pounds' weight, is suspended under the lantern, and is struck by a twenty-pound hammer which is raised and dropped eight times in a minute by a revolving cam, connected by reducing gearing to a one quarter horse power motor, the arrangement being such as to keep the load on the motor approximately



CONNECTIONS OF MOTOR.

constant. The actual power required is less than one-eighth horse power. The motor is bolted to the floor of the lantern, directly under the lamps.

The motor and lamps are controlled by separate switches in the dynamo room of the waterworks, the current being conveyed out to the lighthouse by five lead-covered cables, laid in the water tunnel.

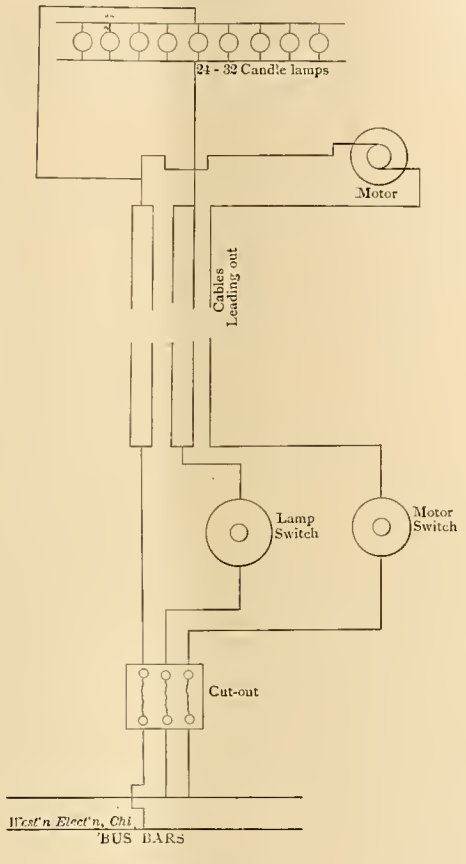
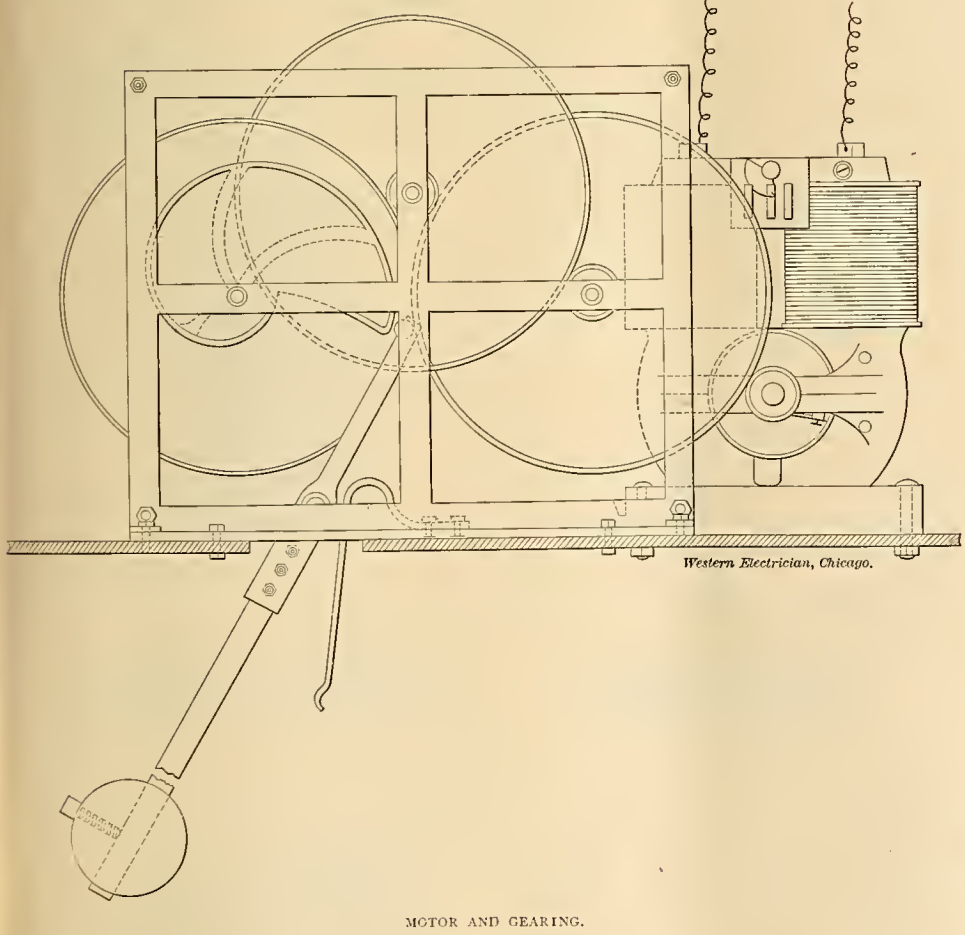


DIAGRAM OF WIRING.



MOTOR AND GEARING.

The lighthouse is operated from the Edison dynamo which supplies the engine rooms and machine shops of the waterworks with light.

The whole plant was installed by Leonard & Izard of Chicago.

Bell Hangers' Hand-Book.[1]

By F. B. Badt.

PART VI.

ELECTRIC ALARMS—Continued.

Chapter XLII.

Hotel, Fire Alarm and Room Call—Continued.

The value of the system is not alone in its capacity as a reliable fire alarm. With it, the clerk can instantly answer the call of a guest; can call a guest at any hour, thus avoiding the necessity of sending the porter to rouse a sleeping guest by pounding on the door, to the annoyance of the occupants of adjoining rooms, or can ascertain at once if a guest is in his room by simply pressing the button on the fire alarm dial corresponding to the room he desires to call.

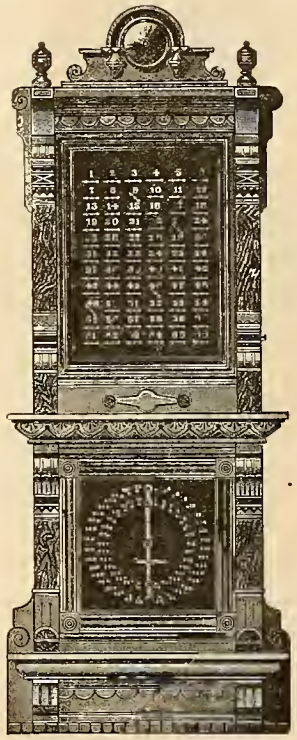


FIG. 55.

The apparatus may be so arranged that the call bells in the rooms will give but a single tap when used as a call, and ring as vibrating bells when operated as a fire alarm. The guest, of course, can answer the call from the office by pressing the push button in his room. Fig. 55 represents a hotel annunciator fire alarm and room call combined.

Chapter XLIII.

The Hess System.

Fig. 56 shows the system of wiring for the Hess combined annunciator fire alarm and room call. The room call device is not shown in detail, the illustration being designed to show the method of wiring only.

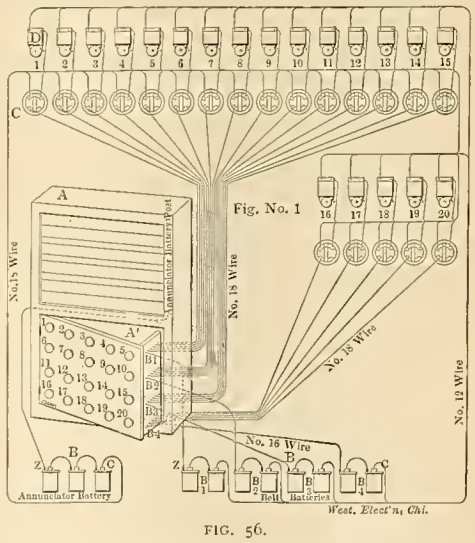


FIG. 56.

The diagram shows the combined system for 20 rooms with battery, bells and buttons for rooms. *A* represents the instrument in the office showing call board *A*[1], partially open, which shows to advantage the battery and room con-

[1] Bell Hangers' Hand-Book, by F. B. Badt, author of Dynamo Tenders' Hand-Book; in course of preparation; about 100 pages, 80 illustrations; flexible cloth binding; type page 6 inches by 3 inches; price $1. All rights reserved.

nections: *B* represents batteries; *C* push buttons, and *D* electric bells.

Directions for installing are as follows: Place the batteries in a cool, dry place, connect the bell batteries in sections of two as shown. Run a wire from the zinc pole of battery, to battery post number 1, on the call board; from post number 2 on battery to post number 2 on board, etc. The annunciator requires from three to five cells of battery. After locating it run a wire from the zinc pole to battery post on annunciator.

The push buttons should be placed some four or five feet from floor with bells directly above them and out of reach of guests. Run a wire from post number 1 on call board to center or main spring on push button in room number 1, from post number 2 to push button number 2, etc. Run a wire from the top spring of push button to either post of bell in the same room. Run a wire from the carbon post of annunciator battery to and through the rooms running a branch wire from it to the lower spring on each push button. Connect the carbon post of each one of the call bell batteries numbered 1, 2, 3, etc,, to a large copper wire, and run this large copper wire through the rooms, with a branch wire from it to the remaining post on each bell in the several rooms. This large wire should have conductivity of number 12 copper wire for 50 bells; where the 50 bells are to be rung simultaneously. If more than 50 bells are to be rung at any one time wire with suitable conductivity should be used. The wires running from the zinc of call bell batteries to battery posts on call board should be number 16 copper, but number 18 will answer when the circuit is short. Number 18 wire will answer for the annunciator return wire and for all leading and return wires, as well as for branch wires. In running wires care should be taken to keep the annunciator and bell return wires separate, if possible. See that good electrical connections are made and that all joints are soldered and taped. In bunching insulated wires they must be left loose. Two cells of good open circuit battery will answer for each battery section except where the bell circuit is unusually long. In that case three cells should be used

In this system each five bells are worked from a separate battery section, either when working singly for guest call or all together for fire alarm call. Bells numbered 1, 2, 3, 4 and 5 are rung from battery number 1. Those numbered 6, 7, 8, 9 and 10, from battery number 2, etc.

Chapter XLIV.

The Western Electric Co.'s System.

Fig. 57 is a diagram showing the Western Electric company's system of combined hotel annunciator, fire alarm and individual call as arranged for 16 rooms: *A* is the annunciator; *B* the call box and fire alarm; *C* the battery operating the annunciator; *D* the battery operating the bells, individually or simultaneously as the circumstances require; the several crosses, x x, indicate the push buttons, on which are three contacts; *E* shows wires running from the annunciator to the call box, connecting to individual springs on the annunciator, numbered to correspond with connecting posts under *A* on the call box.

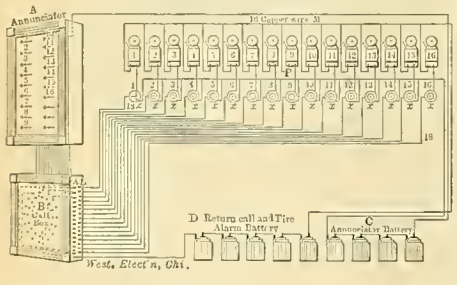


FIG. 57.

Directions for installation: From connecting post on call box arranged in row under *L*, run a wire to the large or main contact on push button x, from the upper piece of metal, or the one coming in contact with the large or main contact, run a wire to one connecting post on the bell; from the other connecting post on the bell run a wire to and connect with number 16 wire *M* as shown in the diagram.

From the remaining contact on the push button run a wire to number 16 wire *P*, this wire being the return or battery for calls from rooms to office

The bells and pushes are located in the rooms usually at the side of the door entering from hall, the bells being placed out of reach above the push buttons. The push buttons are placed about four and a half or five feet above the floor. Care should be taken in running wires, as much as possible, to avoid damp places, and iron and lead pipes or any other metal; also to keep the poles of battery separated as far as possible from each other.

Chapter XLV.

The Double Wire System.

Fig. 58 shows another system of hotel annunciator, fire alarm and individual call designed by the same company. It differs from the one described in the preceding chapter in requiring a double set of wiring. It can be worked with the battery used for the annunciator, by disconnecting wire *B B* from battery number 2 and connecting wire *C C* to wire *A A*, battery number 1, and disconnecting wire *C C* from wire *D D*. The push buttons in this system have but two connections, to either of which the wire that runs to the annunciator can be connected. From the other connecting screw, the other wire runs to the number 16 wire, which runs to the battery, the same wire being used as the battery wire for each one of the bells for fire alarm or individual calls. From the other post the wire runs directly to the connecting post on the fire alarm dial. From connecting post on fire alarm dial *H*, number 16 wire *H H*, runs to one side of the battery; from the other side of the battery going to one connecting post on bell in rooms and to one connecting post on push buttons in rooms. In this system the same size of wire is used as in the single wire system: Number 18 covered copper wire from push buttons to annunciator, and from fire alarm dial to bells in rooms. The battery wire in all cases should be not smaller than number 16. One of the principal features of this system is the small amount of battery required to operate it; in no case is it necessary to use on the fire alarm more than six cells of disque Leclanche, no matter whether the number of rooms or bells is 20, or 120, or even more; and for the calls from rooms to annunciator but four cells of disque

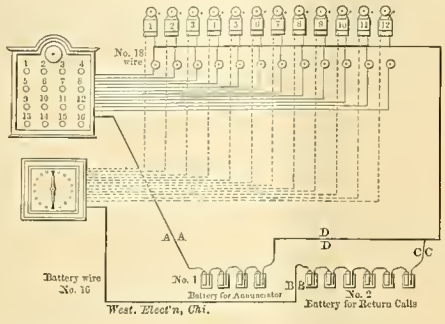


FIG. 58.

Leclanche are necessary. This system requires more wire than the system described in Chapter XLIV, but it is much simpler, more easily wired, and faults can be more easily traced.

Chapter XLVI.

The Electro-Mercurial Alarm.

Electric alarms in Chapter XLI were divided into hand and automatic alarms. Under the first head of this subdivision fire alarms in connection with hotel annunciators have been discussed inasmuch, as stated in Chapter XLII, these alarms are not automatic until they have manually been started into operation. We now come to the second head of the subdivision, automatic alarms. The first of prominence is the electro-mercurial system. This system has three essential elements: Mercurial bulbs or thermostats placed in the ceilings throughout a building; a circuit of insulated copper wire, running through the thermostats, and a battery; and an annunciator and bell placed in a prominent position either within or without the building.

The principal feature of the system is the thermostat shown in Fig. 59 It is a glass bulb, in which a column of mercury moves up and down with the rise and fall of the temperature, with a platinum wire sealed in the glass at each end, the lower wire in contact with the mercury, the upper one terminating just above its surface. This simple bulb, connected in an ordinary electric circuit, is a sleepless sentinel. It is set in the ceiling of a room, and whenever the heat becomes too great for safety the mercury rises, thus completing the circuit; the alarm bell rings and the annunciator shows the exact location of the fire within the building.

The thermostats are inclosed in copper shields and placed in the ceilings, one in every room or closet, in hotels, office buildings and dwelling houses. In all large rooms, such as stores, warehouses and manufacturing establishments, one is placed in every twenty feet, so that in no case can the heat spread over ten feet before its effect will be felt. It is customary to set thermostats at 120 degrees Fahrenheit, but in places where the normal temperature is frequently high, as in engine rooms, laundries and attics, they are set to operate at a higher temperature.

This system is specially useful in stores, warehouses and

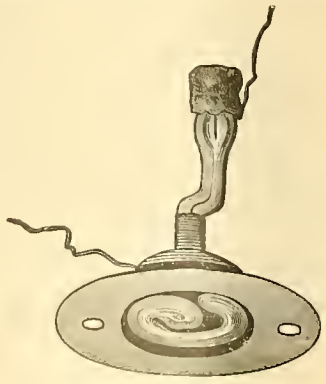


FIG. 59.

manufacturing establishments, in mills and elevators, in schools, colleges, and all public buildings, in hotels and office buildings.

In hotels and establishments where watchmen are on duty at all hours of the night, the fire alarm bell is usually located in the building which is protected. In other cases the bell is placed at some neighboring point where it will attract attention.

In the larger cities complete systems of automatic fire alarms have been introduced. The apparatus used at the central station of the fire department is quite extensive and often arranged for either open or closed circuit. The alarm is received on a register giving the location of the building from which the alarm is given automatically by a thermostat. The annunciator located near the front entrance of the building shows the floor or section from which a thermostat gave this signal automatically. In such central stations only one main battery is used. Testing apparatus is used to give warning of breaks or trouble in the wires or apparatus. Fire departments, recognizing the great utility and reliable character of the system, have always been very willing to receive and respond to the calls of this alarm.

Chapter XLVII.

The Metallic Thermostat.

The principle of the metallic thermostat is the unequal expansion of two different metals, or a metal and some other substance. Fig. 60 is given to illustrate the principle rather than to show the most commonly accepted form. There

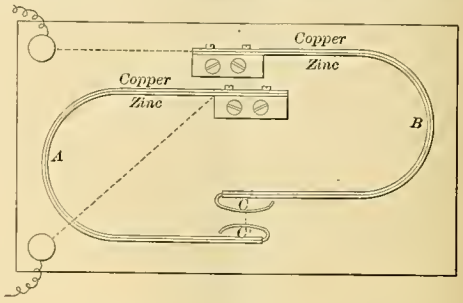


FIG. 60.

are in this illustration two distinct thermostatic couples. They consist of two **U** shaped metallic strips, each consisting of a copper strip and a zinc strip soldered together. One set of strips is thick, and the other thin. They are, however, of the same length, the two zincs being on the inside.

As soon as the temperature rises, the plates are heated and expand; by expanding unequally the two arms of the **U** tend to separate; but as one is fixed, the whole effort is extended to the second arm, which opens out from the fixed point. But the plate B, the bulk of which is smaller, absorbs the heat more readily, so that if the increase is sudden and considerable, as it always is at the beginning of a fire, it expands rapidly and makes contact with A, which, being of greater mass, takes longer to heat and expand. If, on the other hand, the air becomes heated from ordinary causes, the rise in temperature always being more gradual, the plate A has time to expand, and the two contact points C C do not touch. These contacts are made of bent silver or platinum strips, so that the contact may take place in all positions of the plates. The advantages of this instrument are its simplicity, sensitiveness and automatic action for preventing false alarms.

Chapter XLVIII.

Burglar Alarms.

The most efficient means of protection of residences against burglars is the electric burglar alarm.

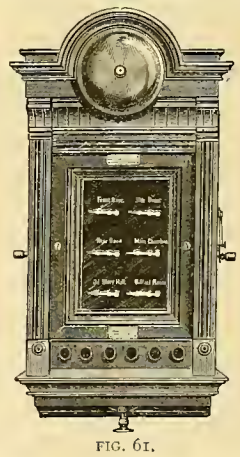


FIG. 61.

The arrangement of the apparatus is generally such, when connected in a dwelling, that the act of opening a

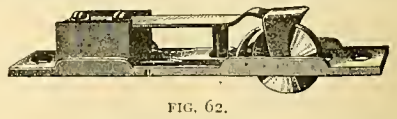


FIG. 62.

window, door or scuttle, will instantly close an electric circuit and cause the annunciator bell to ring. The alarm will continue to sound so long as the opening exists in the house. At the same time the annunciator will indicate in what por-

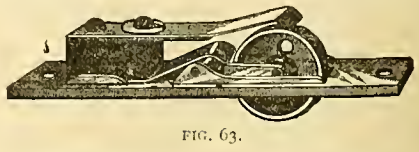


FIG. 63.

tion or room of the house the attempt has been made to break in.

Formerly an arrangement known as the switch indicator was used for the purpose of locating the part of the house

operated upon by the burglar. The substitution of the automatic annunciator for the switch in this arrangement has proved to be a matter of great importance, inasmuch as it enables one to see at the instant where the danger is. The indication once made remains until the pointer is restored.

FIG. 64.

Fig. 61 shows a form of burglar alarm annunciator.

Figs. 62, 63 and 64 represent different forms of window contacts or connections used in this system. The latter being designed more particularly to allow a movement of a window up or down for ventilation without causing the burglar alarm to sound a warning.

Great care should be taken in fitting these contacts properly to the doors and windows, in order to avoid false alarms.

This apparatus for use in residences has been brought to a state of great perfection.

Very often the annunciator is equipped with silent tests,

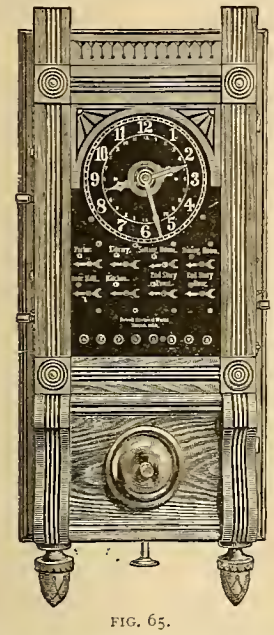


FIG. 65.

continuous ringing attachments and clock work to automatically disconnect the alarm from a part or the whole house at any desired hour. Fig. 65 shows a burglar alarm with clock attachment.

Fig. 66 is a diagram showing the wires and connections,

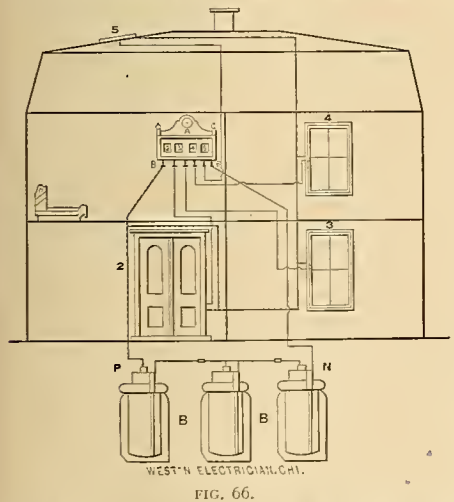


FIG. 66.

in a house fitted with a burglar alarm, having one opening, door or window, in each room, and the scuttle in the roof, numbered 2, 3, 4 and 5 respectively. *A* is the annunciator; *B B* the battery, consisting of three cells; *N* the zinc pole of the battery, from which a wire is run directly to the right-hand binding post *B* of the annunciator. To this wire no others are connected. *P* is the carbon pole of the battery, from which a wire is run to the left hand post *B* of the annunciator, and to this wire, branch wires are connected, running from one side of the spring of each window and door to be protected, as shown by the dotted line. From the other side of each window and door spring a wire is run, as shown, to the remaining annunciator binding posts; this wire from each separate room going to a post whose drop letter, name, or number, as the case may be, corresponds with the letter, name or number of the room from which the wire comes. It should be understood that where there are several doors or windows in a room, the wires from one side of every door and window spring of the room are connected with the battery wire represented by the dotted line; and the wires from the other side of every spring are connected together and then with the wire running to the annunciator binding post, whose drop designates that room. This gives a common route from one side of the spring of every opening in a room to the annunciator post whose drop designates that room. From the other side of the spring of every opening in the same room a common route is given by connecting the wires to the battery wire, as represented by the dotted line. The circuit is thus completed through the battery to the right-hand annunciator post and thence through the bell and each respective drop to the annunciator posts leading to the various rooms.

CHAPTER XLIX.

Desk and Safe Alarms.

The idea of utilizing the electric alarm to give warning of the improper opening of a safe, is not new. But only the closed circuit systems are of much use, as thieves know most of these contrivances, and a wire properly cut reduces the obnoxious bell to silence. With a closed circuit alarm this last resource is denied to the safe-pickers; the cut-wire at once betrays their presence by giving the alarm on the bell, and if the wire is not cut the first movement of the door produces exactly the same effect.

An ordinary electric bell (one closed and one open circuit), two batteries, and internal contacts which break as soon as the safe is opened, are all that is required. The closed circuit battery may be placed in the safe or any other suitable place, and forms the electric source of a circuit completed by the coils of the electro-magnet of the ordinary bell, the wires which lead to the safe, and the contact or contacts, the breaking of which is to give the alarm.

The bell is also in circuit with the open circuit battery in the ordinary way, but with no break in the circuit. The current of the closed circuit battery which circulates continuously in the magnet of the bell, maintains the armature close against this magnet, and in consequence keeps the circuit of the open circuit battery open while the spring of the vibrator and its screw are not in contact. But if from any cause whatever the closed circuit becomes broken, the armature flies back, makes contact with the vibrator, and the bell rings loudly until the closed circuit is re-established.

There is nothing to prevent a multiplication of the bells by placing them at several points. It is only necessary to break the closed circuit at any point to make all the bells on this circuit ring at once.

This use of the closed circuit also enables warning to be given at any moment if the system is not in proper working order, for if by negligence the closed circuit battery is allowed to run down, the bell at once gives the alarm.

This closed circuit battery acts for a long time without renewing, as it is only necessary to keep an armature in contact with its magnet, and a very small current will do this.

GAS LIGHTING APPARATUS.

CHAPTER L.

Electric Gas Lighting Apparatus

Electric gas lighting apparatus may be classified into:
Portable gas lighting apparatus;
Electric gas lighting apparatus for public buildings, such as halls, churches and theaters;
Electric gas lighting apparatus for residences.
The latter class is susceptible of sub-division into:
The plain pendant system,
The ratchet pendant system,
The automatic system.

CHAPTER LI.

Portable Gas Lighters.

These instruments are generally based on the calorific properties of the spark produced by an induction coil, and the internal arrangements allow the use of a powerful battery, taking up very little space. The apparatus consists of a rod of a length to suit the height of the burner, to the lower part of which is fixed an ebonite tube an inch and a half in diameter, and 8 inches in length. The tube divides into two parts, which are shown separately in Fig. 67, and incloses the battery and the coil. The battery is hermetically closed, and has a disk B and a brass rim C on the upper end which form the two poles; when the two parts are screwed together these make contact with the two springs B and C. H is an ebonite tube inclosing and protecting the induction coil K, the secondary wire of which communicates with the brass tube L and a central insulated conductor M, the point of which is near to the end of the brass tube. The currents induced in this wire give a series of sparks between the tube L and the rod M, which light the gas when the end of the apparatus is brought near the burner.

When the end of the tube L is brought near the burner to be lighted, it is sufficient to press the button E from left to right, in order to develop a limited number of sparks sufficient to light the gas. The effect of the motion of the button F is not, as might be supposed, to close the primary circuit of the coil; in fact, in its ordinary position, the vibrator is some distance from its contact, and closing the circuit produces no effect; the motion of F causes a mechanical displacement of the spring of the vibrator, which vibrates for some seconds, and produces a definite number of contacts, giving rise to an equal number of sparks. Owing to this arrangement the expenditure of electric energy required for each lighting is limited, and on the other hand the vibrator is worked mechanically when it would be unable to act if it were necessary for the current to do the work. The required vibrations being obtained from the hand of the operator, the battery is saved this work, and lasts longer.

Fig. 68 is a form of gas lighter, which, although resembling that shown in Fig. 67 in external appearance, is entirely different in principle. It is in reality a small static machine, the plates being spun at great speed by pressing the button sharply. As no battery is used, there is nothing to be consumed, and the whole apparatus being mechanical in action, as long as the parts are not broken, it is an inexhaustible source of sparks sufficient to light the gas.

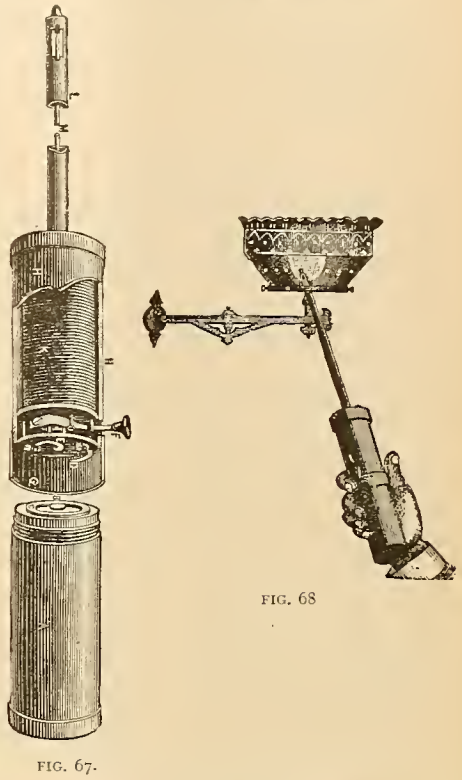


FIG. 68

FIG. 67.

All these lighters act well and render valuable service; they may be considered a natural and indispensable adjunct to domestic electric bells.

CHAPTER LII.

Apparatus for Public Buildings.

Among the most useful applications of electricity is that of the instantaneous lighting of gas in buildings where many jets are used, as, for instance, in churches, theaters, public buildings and depots. The system also proves advantageous in large stores and offices. When the gas is turned on at the meter the stroke of a telegraph key sends an electric spark flashing from burner to burner, and the room is at once in a blaze of light. It is possible to light every gas jet in a large building within a single second.

The central apparatus generally consists of an induction coil, with key circuit breaker, a battery, and a circuit switch, all conveniently placed in a wood cabinet.

The induction coil must meet the requirements of each single case, so it will give a spark of suitable length and volume. Many of the coils which are sold for gas lighting are not made properly, and give a long but extremely attenuated spark, so that the current, instead of passing through the entire circuit of the burners, is apt to jump across and leave some of them unignited. With a coil properly constructed, there is no likelihood of annoyance from the jumping of the spark.

Instead of an automatic circuit breaker, a hand key is

FIG. 69.

generally used. In this way the time for applying the spark is completely under the control of the attendant, which is of great importance, especially in theaters.

The burner, Fig 69, consists of a lava standard and tip, with platinum-pointed poles placed over the tip. The poles of the different burners of a group are connected in series to the switch of the central apparatus, so that the spark passes across all the burners of a group. After igniting one group the switch is turned to make contact to a second group, etc., until all the groups are ignited. Each group of lights has, of course, a gas key near the central lighting apparatus. This key must be opened before the gas can be lighted; the individual cocks on the burners, of course, are kept open all the time. As forty or more burners may be sometimes connected in series in one group, a strong induction coil and a very high e. m. f. is required to give a spark of the necessary length.

(To be continued.)

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CONTENTS OF THIS NUMBER.

PAGE.

Warner Electric Time System, Illustrated.. .. . . 253, 254
Motor for Pumping an Organ..... 254
Westinghouse Acquires Waterhouse..... 254
Extension Foot Push and Clamp, Illustrated 254
Chicago Electric Lighthouse, Illustrated..... 255
Bell Hangers' Hand-Book, by F. B. Badt, Illustrated, Part VI.:
Electric Alarms, Continued..... 255, 256, 257
Gas Lighting Apparatus..... 257
Editorial..... 258
Practical Telephony, by Thos. D. Lockwood, Illustrated, Part XIV 259, 260
New Styles of Push Buttons, Illustrated.... 260
British Association..... .. .. 260, 261

DEPARTMENTS.

Correspondence 261, 262
The Electric Light..... 262
The Electric Motor..... .... 262, 263
The Telephone..... 263
The Telegraph 263
Electrical Patents 264

A TORONTO citizen who had been summoned to court to answer for the infraction of the laws telephoned that he was unable to be present, pleaded guilty, and was fined $1. What a blessing to the community it would be if all litigation could be as easily settled, especially that pertaining to the company who is the father of telephones!

DALLAS, TEX., can boast of two cautious though villainous highwaymen. They entered the city waterworks at midnight recently, and pounced upon the employes. A fight ensued, and it resulted in a drawn battle. An attempt was made to call up the police headquarters for assistance, but the miscreants had taken the precaution to cut the telephone wires.

THE ease with which the electric current can be converted into light or power was never better illustrated than in the brief description of the Chicago electric lighthouse. At this place the current supplies the light that guides mariners by night, and can also be used to actuate a motor that operates a bell in hazy or foggy weather. The installation is a novel one, and will merit careful study. It is a matter for gratification that the first installation of this character upon the great lakes is at Chicago, the home of the WESTERN ELECTRICIAN.

IT is now stated that the graphophone will not be put on the market before January 1st. The instrument is attracting considerable attention. A dispatch gives this description of its use in reporting speeches at Orange, N. J., recently: "Very few of the 5,000 people present knew that the curious funnel-shaped arrangement just in front of the platform was there for that purpose. It in fact reported the greater portion of Gov. Green's speech and that of ex-Senator Winfield. The funnel, seven feet long, looking like a huge cornucopia, was placed in front of the platform, with the large end pointing toward it. The small end was connected with the transmitter of the phonograph, which stood upon a table about nineteen feet distant from the mouth of the speaker. Owing to lack of accommodations the large end of the funnel was not so placed as to secure the best results. After the meeting an exhibition was given of the powers of the instrument. Several persons put the tubes to their ears, and the pleased and wonder-struck expressions of their countenances testified that they heard and understood what the machine said."

A STORY which comes from Indiana indicates the intensity of political excitement in that state a few weeks ago. The floats in the processions grew larger and larger as the campaign progressed. One float attained such height in the latter part of the campaign that when it was drawn through the streets it demoralized a line of wires. It did not occur to the authorities to order a reduction in the height of floats. Processions were of much greater importance than circuits. A new lot of poles was ordered, and the wires were put out of harm's reach. If the excitement had continued much longer, it would have been necessary to bury the wires in order that they might be safe.

In Grand Rapids another campaign electric story is told. A practical politician endeavored to bring the employes of the electric light station to his mode of thinking. He is credited with saying that if his ticket was not elected "England will run wires across the Atlantic and furnish us with light cheaper than you can."

WE have found that the practical work of wiring hotels for a combined annunciator, guest call and fire alarm, is very little understood save by those especially educated to it by manufacturing and installing companies; by the mass of workers in the line of electric bell hanging and kindred work, the subject is not understood, in its details. To such the generous installment of BELL HANGER'S HAND-BOOK published this week is commended in full faith that the chapters devoted to the subject in question will be warmly appreciated. The systems described are among those most widely known and used, and the practical instruction, hints and suggestions laid down, cannot fail to be of the greatest value.

The statement can be made here that as fast as the chapters appear in the WESTERN ELECTRICIAN they are carefully revised, and in a number of cases new matter and new cuts are added. It is the intention, as may be inferred from this statement, to make the book as complete and to have it cover the field to which it is devoted, as thoroughly as possible.

IN the United States Supreme court, last Monday, Justice Miller gave a decision in favor of the plaintiff on a demurrer to the bill of complainant in the suit brought by the United States against the American Bell Telephone companies. The action was instituted in the United States Circuit court in Massachusetts, to set aside the Bell patents on the ground that they were procured by fraud. The Bell company waived answer but filed a demurrer in which it was asserted that the United States in the absence of a specific statute had no right to commence a suit to secure the cancellation of a patent. It was argued that such an action could be brought only by a private party. The Circuit court sustained the demurrer. An appeal was taken by the government. Justice Miller reverses the decision of the lower court and sends the case back to be tried on its merits. The most interesting portion of the decision is the following:

"Each individual affected, it is claimed, can when sued for infringement, set up certain defenses provided by law. On this point the court rules that a successful defense of this character simply establishes the fact that between the individual infringer and the patentee no right of action rests. The patentee may still sue hundreds of other infringers putting each of them to an expensive defense, whereas the suit of the government if successful sets aside the patent and puts an end to all suits the patentee can bring against anybody. It is impossible to suppose that congress in granting this right to the individual, intended to take away or supersede the more enlarged remedy of the government. There is nothing in the statutes expressing an intention of limiting the power of the government of the United States to get rid of a patent obtained from it by fraud and deceit. And although the legislature may have given to private individuals a more limited form of relief by way of defense to an action by the patentee, we think the argument that this was intended to supersede the affirmative relief to which the United States is entitled to obtain a cancellation or vacation of an instrument obtained from it by fraud, an instrument which affects the whole public, whose protection from such a fraud is eminently the duty of the United States, is not sound."

NO one will express surprise on learning that on Monday last the Chicago Telephone company sent to the city council a communication refusing the ordinance recently adopted to govern it in its operations in Chicago. The ordinance adjusted rentals on a new schedule, which reduced the rates from $125 per annum to $95 for the first year, and $85 each subsequent year, or $75 on three years' contracts. The communication was signed by George L. Phillips, president of the company. He says that, with the assent of the city, there has been built an exchange, which is surpassed in point of numbers by only one city in the world. Over $1,000,000 has been expended in improving the service, and in giving to the public the best telephonic conveniences. Misapprehensions, he adds, have arisen as to the rights of the company in the city, of the free telephone service given for these rights and of the fairness of prices. Mr. Phillips shows first that rights of the company rest on the fact that its telephone system was constructed with the assent of the city expressed by permit, contract, ordinance and acquiescence. In its reduced charges to the city for telephones the company is making a concession of $10,000 per annum in excess of the requirements of the ordinance. In discussing the question of fairness of rates, Mr. Phillips says:

"In estimating the fairness of our charges to the public it seems to be generally forgotten that we pay more to a railroad to carry us 1,000 miles than 100, the grocer more for a barrel of sugar than a pound, more for an advertisement in a newspaper of 100,000 circulation and published daily than of 10,000 circulation with only a weekly edition. We say it seems to be generally forgotten, because we are denied an application of the same principles which govern in the cases above mentioned. It is unquestionably true that smaller places charge less per annum to each subscriber than we do, but it is equally true that less is furnished, and that each service or 'connection' costs more in those places than here. The average cost of our service to the subscriber last year in this city was a fraction under 2 cents per connection."

Mr. Phillips, in reference to the new ordinance, says in concluding the communication:

"This company is not disposed to stand only on its legal rights, but is willing to make a fair adjustment of the differences between us, for which purpose we will be pleased to discuss the questions with any committee to whom you may refer the matter. It has been, and is, our policy and our endeavor to conduct the difficult business of this company honestly and with fairness to our subscribers. No effort or expense has been spared to secure the best mechanical devices, constructions and operators. We submit —with due respect—that we know of no good reason why this interest should be singled out by the city, and weighted with burdens imposed on no other corporate interest in Chicago."

The communication was referred by the council to the finance committee. On recommendation of the committee on licenses the city attorney was directed to take steps to have dissolved the injunction which the Chicago Telephone company secured against the city some ten years ago preventing it from interfering with its wires.

Practical Telephony.

By Thos. D. Lockwood.

PART XIV.

No practical improvement was made in the granular carbon transmitter for some time after the evolution of the instrument which I have shown in Fig. 18, and I think chiefly because there was no immediate exigency. But a certain I. D. Husbands, in England, devised a modification that served at least as a pointer, indicating the line of subsequent improvement. This modification consisted in splitting a conducting diaphragm diametrically, and joining the two halves by a non-conducting strip, so that the diaphragm was homogeneous mechanically, but separated electrically. These two halves served as the two terminals or electrodes of the circuit. The diaphragm was placed horizontally, provided with a curved mouthpiece leading to its lower surface, and the granulated carbon was mounted on its upper surface.

The variation of resistance in this instrument took place between the several grains of carbon, and also between the mass of carbon and the two sectors of the diaphragm, the carbon constituting a bridge of weak conducting power from one semi-circular plate to the other.

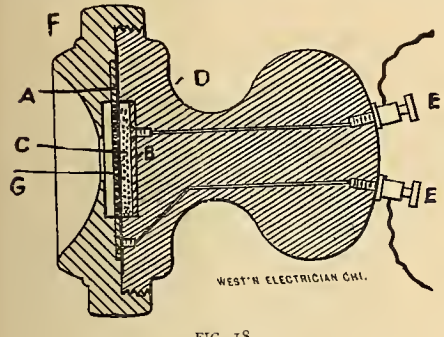

FIG. 18.

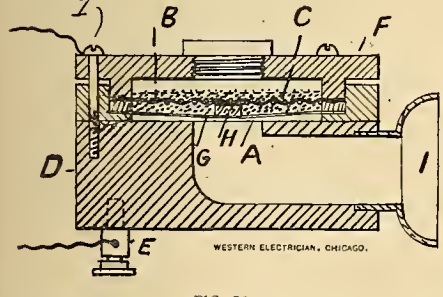

FIG. 19.

Two of the elements of the present long distance transmitter, it will be observed, are incorporated in the Husbands instrument. Mr. Husbands devised a great number of forms involving these elements, and also worked out some, in which strips of metal were interspersed in the carbon mass to reduce its internal resistance. When tried, it was found that this instrument, though loud, did not closely copy the articulations transmitted to it. The speech it forwarded, when reproduced by any receiver, was muffled in character, and mixed with many undesirable sounds. If I should be called upon for an opinion as to the reason of this, I should say that it lies chiefly in the character of the diaphragm, which, being split diametrically and held together by rigid strips across its center, does not vibrate symmetrically, and thus cannot accurately copy the sound waves produced by the speaker.

During the winter of 1884–1885 it was clearly seen that something must be done in the way of making the Hunnings principle available, if telephonic communication over long distances was to be accomplished, and in thinking over the matter Francis Blake, who had already achieved celebrity as the inventor of the Blake transmitter, designed a granular carbon transmitter, which was the beginning of a new epoch of telephonic history.

Fig. 19 represents this instrument as it appears in the patent office drawing. A block of wood, *D*, has a circular-shouldered recess cut in its upper surface, and a curved channel, *A*, bored through from the bottom of this recess at its center to an outlet at one side. The aperture to this channel is fitted with a flaring mouthpiece, *I*. A metal diaphragm is supported upon one shoulder within the recess, and being united by wire to the screw post, *E*, serves as one electrode. Above this, at the edge, is placed a ring, or washer, of non-conducting material. On this ring is in turn supported a circular piece of wire gauze, *B*, with a mesh sufficiently wide to permit the granular material which is employed to circulate freely through it. Between the opposing faces of the vibrating diaphragm and the wire gauze disk at their centers is placed a small piece of some non-conductor, such as hard rubber or leather, *H*, and a metal cap, *F*, fits in and over the recess, and is screwed down, thereby holding the gauze and diaphragm in place. As this is of metal, and as it rests by means of its inner edge upon the edge of the wire gauze disk, it is enabled to serve as the means for conducting the current to the gauze disk. Accordingly, the remaining circuit wire can be attached to one of the fastening screws, as at *I*. A screw plug closes a hole in the center of the metal cap piece, and through this hole the granular carbon, *C*, can be introduced.

Look now at the illustration and observe that this instrument embodies certain principles:

A. It employs granulated carbon in a loose and free state.

B. It employs a horizontally mounted diaphragm which supports the mass of carbon on its upper side, which is provided with a mouthpiece and the regular vocalizing chamber on its lower side, and which serves as one of the conducting electrodes.

C. The complementary electrode is of sieve-like construction, permitting the circulation of the granular current-varying material; this feature was thought to prevent packing.

D. This sieve electrode was *submerged or buried* in the mass of granular carbon.

E. The diaphragm and wire gauze electrode were coupled at their centers, the former being strained tight.

Considerable success attended this new departure; its transmission was loud, and its articulation better than had so far been produced with loud-speaking instruments, while, by its peculiar construction, packing was, indeed, considerably retarded.

Of the five characteristics of this instrument, all except one, the last, have been at least in part retained in the best modern long distance transmitters. The first two were not, of course, new; the third is only now followed, in that the corresponding feature in modern transmitters is adapted to promote circulation; the fourth is still in use, in that at least some portion of the electrode is in all long distance transmitters now made, buried in, or caused to penetrate the granular mass. The fifth characteristic has been found useless, since it impedes the vibrations of the diaphragm, and has been discarded. The production of this transmitter did much to stir up and ventilate the subject of loud-speaking transmitters, and from it all subsequent successes in this line must be dated.

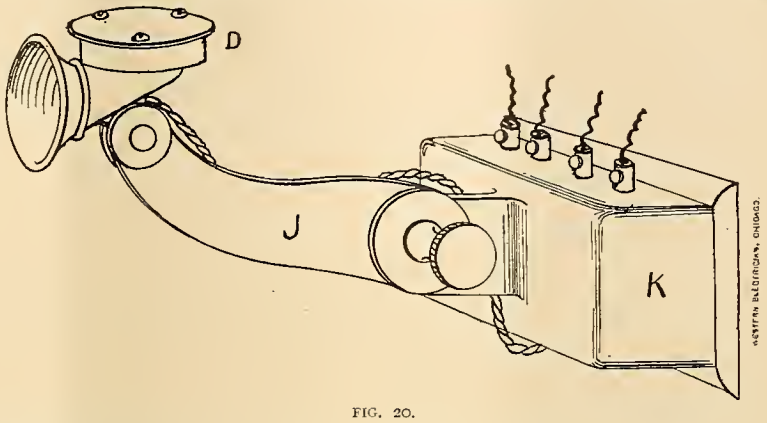

FIG. 20.

The transmitter which has approached the most nearly to being considered as a standard long distance instrument, is shown in Figs. 20, 21 and 22.

In Fig. 20, which, in perspective, represents the long distance transmitter as now used, the transmitter proper, *D*, is mounted upon the free end of an arm, *J*, adjustable as to height, so as to suit itself to either short or tall persons. The supporting arm is hinged to a bracket projecting from a metal box, *K*, within which is the regular induction coil. Upon the upper side of this box are seen four binding screws, two for the primary or battery circuit, and two for the secondary or line circuit. The internal arrangements of the transmitter proper can be reached by taking out the three screws which may be seen on the cap piece, as these screws are the only fasteners employed.

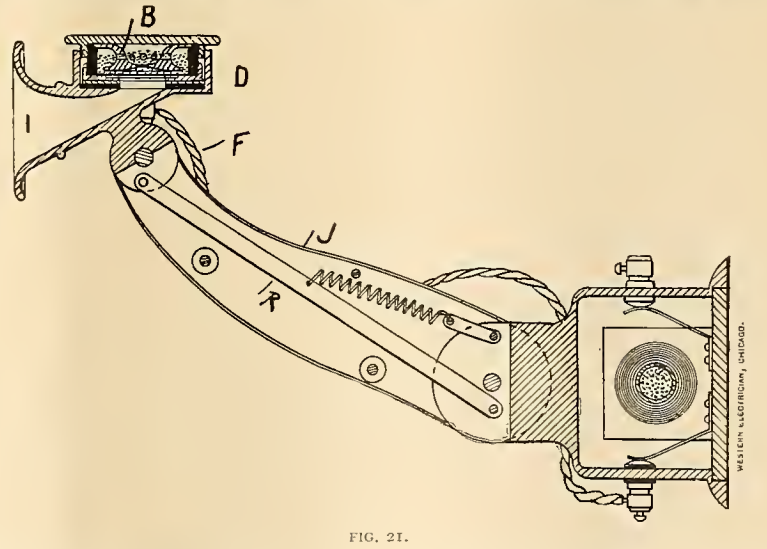

FIG. 21.

The mechanism is clearly indicated by Fig. 21, which is a longitudinal section, the only difference being that a different mode of attaching the cap piece is illustrated.

The transmitting part, *D*, is mounted upon a joint at one end of the arm, *J*, which is itself jointed to the lugs projecting from the coil inclosing box, *K*.

It is a good plan to consider the various parts of this instrument separately. Look first at the transmitter, *D*. It is made of a cast iron or brass framework, and is provided with a flaring mouthpiece, *I*. The mouthpiece terminates inwardly in a central hole, which expands after passing through the lower wall of the instrument into the regular flat vocalizing or air-condensing chamber, closed on one side by the vibrating diaphragm. The diaphragm itself is no longer a stout piece of ferrotype iron, or sheet brass, but is a fragile and thin disk of platinum foil, and is supported at its edges upon a disk, or washer, of metal, insulated from the case by a ring of hard rubber, and provided with a binding screw, which projects below, and to which is connected the flexible conductor, *F*, leading to the lower binding screw on the induction coil box. There is something else about the mouthpiece which should be noticed. Its entire rear wall is seen to have a plane surface; an inclined plane, it is true, but still a plane.

Now the waves and rays of sound, light and heat, when they strike a plane surface at an angle, are reflected therefrom at an equal angle; and the theory is therefore, that if the rear wall of the mouthpiece were curved, the sound waves impinging thereon might roll and reverberate from one point to another, and thus become materially distorted before they could reach and affect the diaphragm. But by constructing the mouthpiece as shown, no matter where the sound wave strikes, it is almost certain to be reflected directly upon the center of the diaphragm. The diaphragm is made of platinum, because platinum does not readily oxydize or form a film of non-conducting matter when in contact with powdered or granular carbon, and also because it has been ascertained that platinum or gold-plated surfaces work better in connection with such carbon than do other metals. It is made of thin foil, partly because the metal is costly, and because therefore it cannot be used in large amounts; and partly because being thin, it is more easily vibrated when carrying a mass of carbon on its upper surface than it could otherwise be.

Note that the interior of the transmitter, *D*, resolves itself into a kind of circular cell, of which the circular side wall is non-conducting; which has a conducting floor on which the carbon rests, and which is closed at the top by a metal cap. It will be remembered that Mr. Blake provided that the fixed electrode should be a buried sieve. The fixed electrode, *B*, in this form of instrument is like, and yet unlike, the sieve.

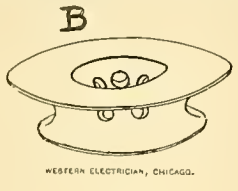

FIG. 22.

Fig. 22 gives a perspective view of this electrode. It resembles an exaggerated and deformed shade roller pulley. It is a most curiously shaped thing, and has upon the whole always given better results than electrodes of any other conformation. One flange is considerably wider than the other, and this serves to hang the electrode from the upper edge of the non-conducting wall, so that the lower flange hangs down into the cavity. A funnel-shaped depression is in the center of the upper surface, and from this depression lateral holes are bored into the deep circumferential groove which surrounds the appliance; another hole also continues straight from the bottom of the funnel through to the center of the lower surface.

The theory of circulation is adopted in this construction. The granulations are originally poured into the upper central cavity, and are shaken down until the cavity remains about half full. The carbon is vibrated when words are spoken to the transmitter, and it is supposed that the vibrations cause the particles to participate in a kind of circulatory motion through the side and central holes; the idea of Mr. Blake is thus elaborated and refined.

The cap piece, when screwed down upon the upper flange of the electrode, connects it electrically with the casing, which serves as one conductor of the primary circuit, the flexible cord, *F*, being the other.

Considering now the supporting arm, *J*, we find that the transmitter, *D*, as before stated, is hinged or pivoted thereto. Persons who have for themselves adjusted the arm of a long distance transmitter to suit their own height must have noticed, that although the mouthpiece might have been expected to change its angle as the arm is raised and lowered, it in fact, does no such thing, but remains absolutely vertical, no matter how the arm is arranged. This is essential, because if it is a good thing to have the diaphragm horizontal, it must also be a good thing to keep it so; and Fig. 21 shows how this is done.

(To be Continued.)

New Styles of Push Buttons.

The Redding Electric company of Boston, Mass., has recently placed on the market several new styles of push buttons, of which two are shown in the accompanying drawings.

Fig. 1 represents a push button to be used in connection with a speaking tube, for front doors and vestibules of apartment houses. It is provided with a name space and number, as shown in cut, is nicely finished in brass, bronze or nickel, with sliding connection, and is in every respect substantial, durable and convenient.

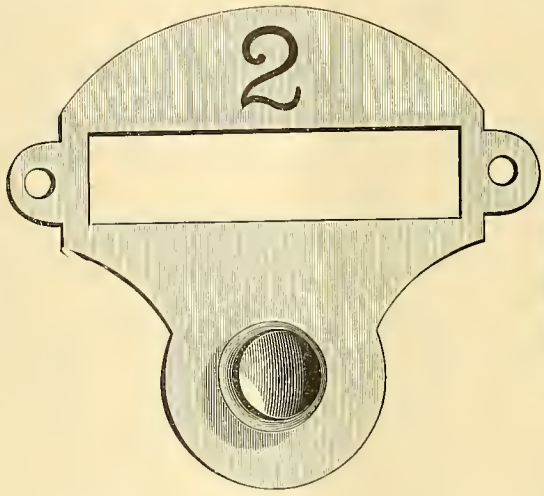

FIG. 1.

FIG. 2.

Fig. 2 shows a new flat, metal push button, for use on outside doors, or to take the place of the common wood push buttons. It can be used on woodwork or plastered walls. It is made of figured bronze, or with plain front, and is finished in brass, bronze or nickel.

The working parts are in keeping with the designs.

The insulating part is made of hard rubber. The wires are fastened by means of large machine screws, which cannot get loose and pull out. The connection is a sliding one. All the parts are accessible, and conveniently arranged, and are made especially strong and durable.

British Association.

Among the papers read at the meeting of the British association was one entitled "Electricity as Applied to Mining." Following is a synopsis:

The recommendations of the mines commission and the passing of the more stringent coal mines act of 1887 have both stimulated mine managers to inquire into and recognize the advantages of electricity for blasting and lighting. By means of a small hand magneto battery and electric fuses all the shot firing in most of the fiery collieries is now done, the explosive used being one of the many lately introduced which, fired by an electric detonator, gave off no flame. Dynamo machines at many pits are used for lighting the surface and main roadways of the colliery, and this current has also been used for the purpose of shot firing, notably at Ynyshir colliery, Rhondda valley, South Wales All the shots are fired in this way simultaneously with every man out of the pit, thus putting loss of life beyond possibility. The adoption of the electric lamp in place of the well-known ordinary safety lamp is now very strongly advocated. There are several in the field, notably the Swan and Pitkin, using secondary batteries, and the Schanschieff, using a primary battery. The South Wales Institute of Engineers, who, with other kindred societies, have lately had these and other electric lamps before them, have referred the matter to a special committee to inquire into and report upon. Several colliery engineers in South Wales are practically testing them—one, G. W. Wilkinson of Risca, having several hundreds in daily use. So satisfied is he with their results that an order has been given for a still further number. The applications of electricity to transmission of power are confined in Great Britain to three collieries only, viz., Trafalgar colliery, Forest of Dean; St. John's colliery, Normanton; and Allerton Main colliery, near Leeds. At Trafalgar, what was a very small pumping plant, started in December, 1882, developed by May, 1887, into three sets of plant, doing the underground pumping of the colliery, and that at a saving of some £500 per annum. At St. John's, a 6 horse power set of pumping plant did such excellent work that a 33 horse power set was put down in March last in another part of the colliery, and has since been in continuous work. These extensions speak for themselves. In each case the power is conveyed by cables from the dynamo at the surface to the pumps placed at a considerable distance underground. At Allerton Main, very small quantities of water are being dealt with at inaccessible points. The power is supplied to the motors from secondary batteries charged at the surface, and conveyed to the required points in the colliery tubs or carts. A coal cutter is also being driven by the same method. On the Continent, underground haulage at Zankerode colliery has been successfully and economically working since 1882, and also at Hohenzollern colliery since 1884, the cost in each case being much less than by horses. There has lately been put in operation at Big Bend, on the Feather River, Butte county, California, the most stupendous set of electric mining plant, so far as the author knows, in existence A large river has been tapped, and with a fall of 300 feet it gives hundreds of horse power by means of Pelton wheels. These actuate electric generators, from which the currents are sent along a circuit of eighteen miles, driving Sprague motors at fourteen different points where power is required in a mining district for pumping, hoisting, etc. The falls at Roaring Fork, Grand River, are utilized for driving an electric generator, from which the power is conveyed across country over a mile to Aspen mines, Colorado, where a 10 horse power Sprague motor is driving the mine machinery, replacing steam power with considerable economy. A gold mine in New Zealand has recently been made valuable by transmitting the power from a waterfall two miles away. The conductors, supported on poles, are carried direct over the mountains, 2,000 feet intervening between the fall and the mine. Obviously, where water power can be thus applied, the saving, as compared with using fuel, is considerable, especially in metal or diamond mining districts, where coal is expensive. The ease with which the power can be conveyed over hill and dale and into the intricacies of the mine is, too, a factor of no mean importance.

W. Anderson read a paper on the application of electricity to the working of a twenty-ton crane at the Erith iron works. Rope driving gear was at first employed, but the inconvenience and wear induced Mr. Anderson to employ electricity. The following description of the crane was given: "The crane is 39 feet 6 inches span, and consists of a pair of wrought iron girders resting on end carriages, each running on two wheels on an elevated line of rails. The gearing for hoisting for longitudinal and for cross traverse is secured onto the tops of the main girders; the hoisting chain passes from the barrel, which is at one end of the crane, over a pulley at the other, then back to pulleys in the cross traversing carriage which runs between the main girders, thence to a falling block, and finally to an anchorage under the barrel at the extreme end of the main girders. By this arrangement the crane occupies a moderate height, and the hook can come within 3 feet of each wall.

"The dynamo, which is considerably larger than is needed for the crane in question, is arranged to give up to 80 amperes at 120 volts, with 1,200 revolutions per minute. The armature is of the cylinder type. field magnets shunt wound, resistance of armature .07 ohm, and of the magnets 75 ohms. It is fixed in the main boiler house of the works, and is driven by a horizontal engine, having a cylinder 9½ inches diameter, 12 inches stroke, running at 180 revolutions with 50 pounds steam by means of a link belt. The leads from the boiler house up to the conductor in the foundry, for a distance of 60 feet, are of No. 6 B.W.G copper wire, while the conductor in the foundry is formed of an angle iron bar, 2 inches x 2 inches x ¼ inch, extending the whole 350 feet length of the shop; it has one

face, roughly ground, and protected from rust by vaseline, and is secured to the iron pillars supporting the roof, being insulated by wood blocks. The return current travels along one of the rails on which the crane runs, the joints of the rails being united electrically by copper staples. The motor is one of Elwell-Parker's latest types, with single vertical magnet and a drum armature; it is shunt wound and constructed for 100 volts and 50 amperes, the armature resistance is .056 ohm, that of the shunt 49.2 ohms. It is fixed on the working platform of the crane, beside one of the main girders. Its driving spindle carries a steel pinion, which gears into a double helical spur wheel, keyed on to a shaft which runs longitudinally on the top of the girder, and is connected by nests of three-bevel wheels, with friction clutch connections to the three shafts which command the several movements of the crane, the means of using the hand-power being still retained. Two sets of speed are arranged for each of the movements, namely:

	Slow per min.	Fast per min.
"Hoisting	3.4ft.	10ft.
Cross traverse	25 "	105 "
Longitudinal traver e	78 "	213 "

"To provide against an undue current passing through the motor an automatic magnetic cut-out is fixed on the crane, and as an additional security a fusible wire is placed close to the dynamo to provide for the contingency of a short circuit. For the purpose of varying the power and speed to meet the requirements of the foundry a set of resistance coils is provided governed by a special switch, by means of which different resistances can be introduced into the armature circuit of the motor, and the current can be cut off altogether; but so that it must be done by steps, and not suddenly. In starting the motor the reverse action takes place. The shunt coils of the magnets are connected to the two collectors so that the fields are always excited when the dynamo is running, whether the motor is working or not, the switch controlling only the armature circuit. The collector for the angle-iron conductor consists of a pair of insulated brass blocks pressed against it by means of a flat spring having a considerable range. An ordinary wire brush serves to collect the current from the rail; but the axle of one of the wheels is also connected to this brush to provide for the contact being in any way interrupted.

"The handles for operating the several movements, the brake lever, the switch, and the automatic cut-out are all collected together, so that a single attendant can readily work the crane from one spot.

"The crane was set to work in June last, and has continued to act satisfactorily ever since The advantages of working by electricity are very great, especially in comparison to steam cranes. In large works a powerful dynamo would be established, and be driven by engines of an economical type. The steam from the main boilers is necessarily always available when the factory is at work, and the current can be easily carried into any part of the establishment. Steam cranes require attendant to be at his post an hour or more before the works open, water and fuel have to be hoisted on to the crane, and the working is accompanied by dirt, steam and smoke, the latter especially objectionable with overhead lights, or in shops where bright work is prepared or erected.

"The duty realized is about 65 per cent. of the power developed in the driving steam engine. As far as can be judged at present, there is no special wear to apprehend. The conductors act satisfactorily though a considerable length is in the open air, and the dust, heat and smoke of the foundry do not appear to affect the working."

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 8.—The most important use of electricity during the past week has been the gathering of election returns, and the work has been satisfactorily done. There has been little of that doubt and uncertainty which nearly resulted in a riot four years ago, although there was a slight attempt to prolong the agony for another day. A little excitement was created at the headquarters of the Cleveland Business Men's association on election day by a blunder in a telephone message transmitted from Commissioner Davenport's headquarters, in which he said he had issued warrants for the arrest of the entire Board of Inspectors of the Sixth election district. The Police commissioners called on the Business Men's association to furnish substitutes for those arrested, and the man who received it understood the number to be 100. It proved an entirely false alarm, however, as none whatever were arrested.

This year the long distance telephone people entered the field as collectors and distributors of election returns, and their success will no doubt lead them to make careful preparations in the future, while their extension of lines will enable them to cover the field in the close states in the east very satisfactorily.

Herrick P. Frost of New Haven, Conn., one of the telephone pioneers of New England, died last week after a year's illness, and upon the expiration of his six months' leave of absence as general manager of the Southern New England Telephone company. Mr. Frost was engaged in the wholesale grocery and liquor business when, in 1877, the first telephone company was organized in Connecticut. He at that time turned his entire attention to the introduction of the telephone, and, in company with George W. Coy of Milford, Conn., established one of the earliest exchanges, which began business in January, 1878. He was the chief organizer of the Southern New England and the Chesapeake & Potomac Telephone companies. He was also interested in New York, New Jersey and Colorado companies.

The Commercial Cable company has announced its intention of increasing its capital stock from $6,000,000 to $10,000,000, taking up its standing bonds as fast as they mature, and anticipating the payment of others. It is said that $600,000 worth have already been retired. This movement on the part of the company is believed to be due to the better condition of the cable business since the recent increase in rates, under which the company is working its cables to their full capacity. This change in the conditions has been very gratifying, as the volume of business has not fallen off by reason of the higher tolls. The French Cable company reports an increase of business, which may be attributed, it is thought, to the activity in the cotton and coffee markets.

Much interest is felt in the proposed new series of experiments with the Daft motor on the Ninth avenue elevated road. The power of the motor has been doubled since the original trial some time ago with a view to showing what can be done with a train of five cars on the grades of that line.

The Railway Cab Signal company has been experimenting with Putnam's cab signal on the Staten Island railroad for about eighteen months. Although not officially adopted it has been carefully watched, and appears to be now entirely perfected One of the most serious defects of all other signaling systems appears to be the necessity of depending upon the sight of the engineer. In the Putnam system the danger signal is sounded by a vibrating bell or shrill whistle in the cab, which continues until it is switched off by the engineer or fireman, who may be awakened by the sound, if sleeping at their posts. It will be recollected that the recent Mud Run disaster occurred in spite of the display of signals, which must have been easily seen from the fireman's side of the engine. It is fair to assume, that with an audible danger signal of this character that terrible accident would never have occurred.

There was a boiler explosion at the chemical works at Lancaster, Pa., last night, by which one boiler out of a battery of four was thrown over the buildings, landing about 100 feet away. It was used to supply power for the United States Electric Light company, which lights the streets of that city. Charles F. Miller, president of that company, who was in the engine room at the time, was bruised by flying bricks, but not seriously injured. John Reidel, an employe, was killed, and Michael Klonn badly hurt. The engineer was slightly injured. There was plenty of water in the boiler, and the steam gauge registered but 80 pounds. All of the boilers were less than eighteen months old, and an inspection only five weeks ago showed them to be in first-class condition. P.

Kentucky Notes.

PADUCAH, Ky., Nov. 9.—Capt. R. K. Dunkerson of Evansville, Ind., a large stockholder in the Paducah Gas company, and also in the electric light company, is in the city. Capt. Dunkerson said that all the machinery of the electric light plant had been contracted for. Part has already arrived, and part is now on the way from Pittsburgh. The only delay feared is in the construction of the immense boiler now being built by Heilman at Evansville. "If we had this here now," said Capt. Dunkerson, "we could furnish the people of Paducah electric light within two weeks." J.

PARIS, Ky., Nov. 9.—Thomas H. Feary, representing the Thomson-Houston Electric Light company of Chicago, was here last week to see what might be done in the way of illuminating Paris with electric lights. He claimed that it could be done for $2,000 per annum, while it now costs $3,300 for gas. Mr. Feary is expected to return here this week. K.

Canadian News.

MONTREAL, Nov. 9.—A short time ago the secretary of the fire and gas committee of the Montreal city council was instructed to communicate with a number of American cities, and collect what information he could respecting the placing of telephone telegraph and electric light wires underground. Replies were received from New York, Detroit, Philadelphia and St. Louis. In the first case a report was forwarded showing what had been accomplished by the placing of electric conductors underground. In the second the fire commission of the city had underground 15 miles of conduit, and the cable laid therein worked with entire satisfaction. In the third instance there were 583 miles of wires underground, of which 56 were for electric lighting purposes, the remainder being for telegraph and telephone purposes. And in the last instance, St. Louis, the system had not yet been adopted. There is a strong feeling at the City hall that the placing of all these wires underground in Toronto would prove an immense advantage to the city.

At a recent meeting of the Canadian Society of Civil Engineers, at McGill college, F. N. Gisborne, F. R. S. C., of Ottawa, read an interesting paper upon the "Inception of Electrical Science, and the Evolution of Telegraphy." He concluded his paper by stating that, in his opinion, the most successful and profitable telegraph companies of the future will abandon the present system of a multiplicity of wires for the transmission of intelligence; and at business centers and important stations will employ female labor for perforating and comparing with the original manuscript dispatches to be forwarded by automatic transmitters; an additional wire or two being operated by Morse sounders for the correction, when needed, of automatically transmitted messages, and also for the requirements of intermediate local business. Such additional wire or wires would be available for duplex, quadruplex, or multiplex instruments. C.

Akron, O.

AKRON, O., Nov. 9.—The electric road is now in full operation, and is giving great satisfaction. According to the articles of agreement with the city the street car company is bound to run cars in all directions from the corner of Market and Howard streets every ten minutes. This is now being done on all lines except East Market street and as soon as a switch can be put in, so that the cars can pass near Adolph avenue, another car will be put on, and the company will then be able to fulfill the agreement to the letter. When a few changes are made the city can boast of having the best street car system in the state. Forty horses that have been used upon the system will be taken to Erie, Pa., by the company, and will be used on horse car lines in that city. Charles Foote of the Sprague Electric Railway & Motor company; Henry Everett, a prominent railroad man, and Mr. Emmett, all of Cleveland, recently inspected the road. Mr. Emmett has charge of the construction of the road in the Forest city.

Several officers of the Central Union Telephone company were in the city a few days ago looking after their interests here. They carefully looked over the condition of the exchange, and have decided to give the whole plant a thorough overhauling and reconstruction It was the intention of the company to start out in brand new quarters when the franchise was renewed, but as yet they have been unable to secure a desirable location All of the wires which are now in Bank alley will be replaced by two 100 conductor cables. B.

Pittsburgh, Pa.

PITTSBURGH, Nov. 10.—The buildings of the Pittsburgh Carbon company were destroyed by fire recently. It is estimated that the loss will be in the neighborhood of $30,000. The buildings were partially insured.

The South Thirteenth Street Electric Railway company is working hard to get the new circuit in along Barkheimer street and Southern avenue. This work will be accomplished in a few days, and the heavy motors will be put in. With these a much greater degree of speed can be obtained.

The Westinghouse Electric company recently installed a new plant at Trenton, N. J., of 3,000 incandescent lights.

It is proposed to establish a technical school in connection with the Western university of this city. If the project is carried out a thorough course in electrical engineering will be included in the curriculum. Members of the board of trustees have recently been visiting polytechnic schools to obtain ideas concerning the establishment of such a school. A.

Boston, Mass.

BOSTON, Nov. 10.—At a recent meeting of the Society of Arts, Charles A. White of Boston, exhibited and described the Eco magneto watchman's clock. Mr. White mentioned as the main defects of the clocks now in use the ease with which they can be cheated by unscrupulous watchmen, the troubles arising from a chemical battery, the necessity for an expert electrician for their care, and the fact that the breaking of any part throws the whole out of order, The Eco clock dispenses with the battery, the current being generated by the act of registering at any station, and as each station is independent of all others, a break on one affects only that one. The recover in this clock is entirely by gravity.

W. E Gump of New York, described the writing telegraph.

An effort is being made by the press to have wires put under ground. D.

St. Louis, Mo.

ST. LOUIS, Mo, Nov. 9.—The first steps toward the organization of an electrical society have been taken in this city. The temporary officers are: David J. Harris, president, and S. P. Baird, secretary. The committee on ar-

rangements is composed of Messrs. Harris, Dean, Graber, Baird, Wurdock and Rogers. The object of the society is to advance the interest in electrical study by opening a room where all can meet and exchange views on telegraphy, electric lights, distribution of electric power, etc. Papers will be read by professors, electricians and practical men.

B.

THE ELECTRIC LIGHT.

The electric light plant in Findlay, O., is now in operation.

Belle Plaine, Ia., is making a move to secure electric lights.

Work has been commenced on the electric light plant at Ravenna, O.

Gainesville, Fla., will soon have its electric light plant in operation.

LeMars, Ia., Water & Light company has been organized with a capital stock of $100,000.

The plant of the Electric Light & Power company, Knoxville, Tenn., will soon be in operation.

The citizens of Lyons, Kan., are discussing the advisability of enlarging its electric light plant.

An effort is being made at Centreville, Md., to organize a company to put up an electric light plant.

The Burlington, Ia., Edison Electric company has been incorporated with a capital stock of $200,000.

W. H. Cole has resigned his position of manager of the Virginia Light & Power company of Richmond.

The office of C. C Haskins, inspector of electric lights in Chicago, has been moved to the city hall building.

Leon, Ia., operates and owns its own electric light plant, and lights the city. Plant and light for a year cost $10,000.

The city council of Atlanta, Ga., has voted to increase the number of electric lights for street lighting from 100 to 130

The Western Electric company is lighting the Exposition building with eighty arc lights for the Chicago fat stock show.

The city of Statesville, N. C., has decided by a popular vote to issue $8,000 in bonds to purchase an electric light plant.

The Jenney Electric company of Fort Wayne, Ind., is installing an electric light plant in Jackson, Miss., for street lighting.

The Detroit Electric Light company of Detroit, Mich., is seeking to introduce its tower system in the city of Cleveland, O.

The Jenney Electric company of Indianapolis, Ind., has recently sold to the Sidney Gas Light company of Sidney, O., a $7,500 light outfit.

The Citizens' Electric Light company of Natchez, Miss., talks of adding to its plant incandescent lighting machinery of a capacity of 1500 lights.

The streets of Rochester, N. Y., are illuminated by 2,852 lights. Of this number 980 are arc lamps, 895 are incandescents, and the remainder gas.

The Van Depoele company's first incandescent dynamo has been sold to the Ferracute Machine company of Bridgeton, Conn. It is a 200 light machine.

The officials of the county buildings at Denver, Col., have petitioned the county commissioners to substitute electric lights for gas for lighting the offices.

The contract for lighting the city of Natchez, Miss., has been let to the Thomson-Houston company at $85 per lamp per annum for sixty-five lamps, all night schedule.

Richmond, Kan., is talking of having its streets lighted with electricity It is believed arc lights will be used if any. About fifty in number, it is thought, would be sufficient.

The Consolidated Electric Light & Power company at Aurora, Ill., has been organized; capital stock, $50,000; incorporators, Ira B. Copley, Howard Knowles, and I. C. Copley.

The joint committee on lighting of the Cleveland city council voted at a recent meeting to discontinue the use of the electric light masts, and to distribute the lights about the city.

The Central City Electric Light company, Waco, Tex., capital stock $30,000, has been organized by M. D. Herring, Samuel Sanger, Travis Jones, James Moore, James B. Baker and others.

The Westinghouse Electric company has applied for a patent on a regulator of electric lights a long distance from the central station. It is the invention of Mr. Stillwell, one of the electricians of the company.

The Electric Light association of Waupaca, Wis., has decided to rebuild the dam which was wrecked some weeks ago, and put the light plant in operation again. The work will cost between $5,000 and $6,000

The work of preparing to light the business district and a portion of the west side, Chicago, by electricity has been steadily going on, and the probability now is that the dynamos will be put into use to celebrate Christmas day. The work would have been finished some weeks ago and the light turned on but for the many obstacles encountered. At first there was a dearth of money to put in the necessary machinery, and next came trouble about getting material, but both have at last been overcome, and there is now nothing in the way of the improvement being completed by the time fixed.

The judiciary committee of the Vermont legislature has under consideration a bill granting the use of electric light poles to other like companies under the direction of the selectmen of towns, and the aldermen of cities.

Judge Rorey, in the Superior court of Georgia, has ordered the sale of the entire plant at Augusta, of the American Illuminating company, whose electrical apparatus was damaged by the recent floods. The company has been in the hands of a receiver for some months.

Thomas A. Edison has applied to the courts to stop the publication of his pictures in newspapers as part of an advertisement of a remedy with which his name is associated. He doesn't consider them as libelous as some candidates' cuts are, but says he doesn't intend to be made a rival of Lydia Pinkham.

The Chicago & Great Western Railroad company is having plans traced for its proposed passenger depot on the corner of Harrison street and Fifth avenue, Chicago. The train shed will cost $150,000, and the entire structure in the neighborhood of $600,000. All modern improvements will be used, including electric lights, steam heat, and elevators.

The Citizens' Light & Power company of Burlington, Vt., has been organized. The directors are: Edward Lyman, C. C. Post, Willard Crane, W. S. Vincent, Elias Lyman and E. A. Pope. The company expects to be able to furnish the electric light and power within sixty days. The Thomson-Houston system will be used. The company will use water power, but will put in a steam plant as a reserve. The choice of engine has not been made.

It is stated that about 4,200 horse power will be required for the lighting of the exhibition to be held next year in Paris. Of this about 200 horse power is to be supplied by gas engines. The lighting will be effected by 20,000 incandescent lamps and 1,000 arc lights. The work of preparation in the Champs de Mars is being vigorously prosecuted, and it is confidently expected that the exhibition will be completely ready by the date fixed upon for the opening.

The president of a leading electric light company of New York city is quoted as saying: "There are, according to the latest statistics, about 150 tons of carbons in daily consumption, and out of that number a shade over 100 tons are turned out in the twenty carbon furnaces in Cleveland. The capacity of an ordinary furnace is about 45,000 carbons, but some of the manufacturers are now running overtime, so great has the demand grown. Six years ago all the carbons burned throughout the country were made in a single room in Boston, where only ten men were employed."

A New London, Conn., paper says: For a number of months several churches in Bridgeport have been considering the advisability of substituting incandescent electric lighting in the place of gas, but it remained for the South Congregational church of that city to be the pioneer in the change. Men are now at work putting in the requisite wires and fixtures and it is expected that by Sunday evening next, the edifice will be aglow with this brilliant illuminator. The Huntington Street Baptist church in this city is illuminated by the incandescent system, and it appears to give the highest satisfaction. Other churches here will probably follow the Huntington Street church and introduce the system

At a meeting of the St. Paul, Minn., common council, November 3d, Ald. Cooley, from the committee on underground conduits, submitted a report, recommending that the city engineer be directed not to issue any further permits to conduit companies which do not have underground franchises, until permission had been granted by the council. The alderman also introduced an amendment to the original conduit ordinance, preventing the engineer from issuing permits to all applicants, until the plans for additional conduits are approved by the council. The object is to protect those who are operating under franchises heretofore granted by the council. The amendment was adopted, with only one vote in the negative. The superintendent of the fire alarm telegraph was instructed to see that the city wires were properly distributed in the conduits and the necessary connections made while the work of construction is in progress—the subway company having granted the city the free use of its conduits.

The following is an extract from an article in the Pittsburgh *Chronicle:* "What effect has the adoption of electricity as an illuminant had upon gas?" The above question was asked this morning of a prominent manufacturer of illuminating gas in a neighboring state, and one who is justly considered an expert on the subject. His first reply was that it had had none unless to increase the demand for gas, but after a moment's reflection, he added that the question was more comprehensive than his answer would seem to imply and he would, therefore, go more in detail. "The general introduction of electric lighting," he continued, "has been the cause of numerous improvements in gas lighting methods, for the competition brought about between the two systems made it necessary to increase the efficiency of gas as an illuminating agent if it was to hold its own against its younger rival. One very noticeable effect was the reduction in the price of gas, which was a simple way to increase its efficiency on a basis of dollars rather than of cubic feet. There is a minimum limit, however, at which gas can be profitably manufactured, and when that is reached, increased efficiency must be sought in the direction of better quality or improved forms of burners. One source of economy is heating the gas before it is burned, thus producing a white flame. This principle, which is not novel, is applied in several ways and with varying success."

THE ELECTRIC MOTOR.

The Baxter Motor company, W. W. Munroe, Chicago western agent, has sold a four horse motor to the *Chicago Herald* Publishing company to run machinery in the engraving department

The Electric Motive Power company of Spokane Falls has been incorporated; capital stock $50,000; trustees, A. S. Moore of San Francisco, W. S. Norman and C. R. Burns of Spokane Falls.

At a recent meeting of the Buffalo, N. Y., common council, the People's Electric Railway company made an application for permission to lay tracks on several streets. Hearing was postponed two weeks.

The West Haven Horse Railroad company of New Haven, Conn., is considering the adoption of electricity as a motive power. The officers of the company are inclined to favor the Julien system of storage batteries.

Some of the aldermen of this city pretend that the system of electric motors for street railways is not a success, says the Peoria *Journal.* And yet city after city is adopting it, so if we do not soon move in the matter we shall be left behind.

A force of men is now at work on Oak street, near East End avenue, Chattanooga, Tenn., making the necessary cut for laying the track of the Chattanooga & Highland Park Electric railway. This will be finished in a short time, and then track laying will be pushed rapidly.

The Daft Electric Light company has brought suit against C. H. Howland and individual members of the Los Angeles Electric Railway company of Los Angeles, Cal., to recover $15,684 claimed to be due on the plant of the road. C. M. Whaling also began suit against Howland to recover $856, his proportion of $2,195 due for work on the road and claims assigned.

The Seattle, W. T., Electric Railway Power company contracted with the Thomson-Houston company of Boston for the entire electrical equipment for the road, $35,000 being the consideration. Contract has been awarded to J. W. Jones & Son of Troy, New York, for car bodies for $4,000. The Jarvis Engineering company of Boston will install an engine and boiler at a cost of $6,000.

The Steubenville, O., *Gazette* says: "The system of electric street car motor to be employed in Steubenville is the same as that adopted on the Beacon street line, Boston, in preference to horse or cable motor. Beacon street is the finest street in Boston, and when the people agreed to have a street car line put on that street the cable system was adopted, but abandoned after a committee went to Richmond and saw the Sprague electric system in operation."

The following is taken from the Fargo *Daily Tribune:* "Lieutenant Gilman, who recently arrived from the east, regrets very deeply that his electric street railway will not be in operation for the accommodation of the distinguished law makers who will assemble in the city next January. However, the railway will be constructed. Although the visiting solons will not have the pleasure of riding in its palatial cars, the citizens of Bismarck will in the near future revel in the luxury of being snatched over the streets by electricity. Lieutenant Gilman has not lost faith."

Omnibuses driven by power from accumulators are said to be running for conveyance of passengers in Paris. A London paper in referring to this subject says: Some day soon we may have electric omnibuses plying in the streets of London; indeed, an experimental 'bus may occasionally be seen making a journey in the evening in some of the West End streets. The vehicle is the invention of Radcliffe Ward, who has been connected with several electric companies. The electric 'bus, to carry 12 persons and the engineer, costs about 20 per cent. more than an ordinary horse omnibus, but the expense of working and maintenance is said to be 50 per cent. less.

The aldermen of Decatur, Ill., recently visited Lafayette to examine the electric road in that city. A Decatur paper says of the visit: All were highly pleased with the electric street railway. The poles already on the streets had been used for the necessary wires in the business center and the poles were generally no more objectionable than those of telephone or electric light companies. The central plant had engines of 130 horse power, and it was clearly demonstrated that loaded cars could be run up a 5 or 10 per cent. grade. The perfect satisfaction expressed by the people of Lafayette has removed every doubt in the minds of Decaturites. The organization for Decatur is now complete, and a petition will be presented to the council asking for right of way for five miles of street railroad. The company will push things as soon as right of way is granted, and they expect to have the entire line in operation by July 1, 1889. The enterprise represents an investment of from $50,000 to $100,000.

An Omaha paper says of the Thomson-Houston electric road at Omaha, which was started for traffic October 30th. The plant established will give abundant power for fifty cars. But twenty-six will be used at present, which will be a rate of one car every six minutes. The cars will be heated in winter by gasoline stoves and lighted by incandescent electric lights. The power house is situated south of the car shops on Avenue F, and is 43x80 feet. It is very substantially built of brick and finely finished. A huge chimney, 175 feet in height, towers above the structure. The chimney is sixteen feet square at the base, and has a four-foot flue. The interior of the building is divided into two large rooms, one containing the boilers, the other the two Westinghouse engines of 150 horse power each, and the four large Thomson-Houston dynamos. One of the dynamos furnishes the electric light used in illuminating the bridge, and the others generate the current that furnishes the motive power. The machinery already in the building will generate sufficient power to operate a line double the length of the present one, and there is ample

room for additional machines. On the bridge alone, independent of the approaches, will be placed twenty 2,000 candle power arc lights. They will be placed 100 feet apart, and will illuminate the structure at night in a very brilliant manner. The approaches will also be brightly lighted.

They are making great headway with the rapid transit problem in Baltimore. The *Sun* of that city says: "With a short clay pipe stuck in the side of his mouth and seated in a boatswain's chair, which was attached by a pulley to a telegraph wire, John H. Lewis, a lineman in the employ of the Chesapeake Telephone company, yesterday rode from the building, South and Baltimore streets, to the Chamber of Commerce building, over heads of people and tops of houses. The wire between the two buildings was out of order, and Lewis proceeded to repair it. The chair was attached to a rope, to the end of which a pulley was attached, which slid over the wire. When he sat in midair over South steeet a number of persons stood watching him."

The Birmingham, Eng., Central Tramways company has been experimenting with an electric locomotive designed to draw a detached train. The London *Electrician* says: "Although this car is little more than half the size and weight of the steam locomotives in use at Birmingham, yet the dynamometer tests showed that it was able to exert a tractive force 66 per cent. greater. The Birmingham Central Tramways company is looking into the question of electric traction with perfectly serious intentions. Their experience of steam locomotives—of which they possess no less than 76—is not of a wholly favorable character. The wear and tear is something enormous. A tire of 4 inches in thickness is only good for 27,000 miles—that is, about nine months' use—by which time it has been reduced in thickness to 1¾ inch, and this is in addition to an equally excessive wear of the axles. What this means in the way of expense and trouble for continual adjustment in case of so complex a machine, some of our readers will be able to appreciate. With electric traction the greater part of this trouble will be avoided."

THE TELEPHONE.

The telephone line between Madison and Norfolk, Neb., has been completed.

The Atlanta *Constitution*, in an article on the utility of telephones, sums up the matter thus: "Much has been said in regard to the use of the telephone, still there is room for its merits to be more fully explained in order that they may be more highly appreciated."

Judge Bunn has granted a temporary injunction closing the exchange of the Superior Telegraph & Telephone company at Superior, Wis. The injunction was granted in favor of the American Bell Telephone company. The case will come up on its merits later. The Bell company alleges infringement

A movement has been begun in Portland, Ore., to cause the companies there to bury their wires. The *Oregonian* of that city says: "The time is not far distant when it will become actually necessary to put the telegraph, telephone and other electric wires underground in Portland, and it would be just as well to begin to consider the matter now. Indeed, the network of wires has already grown to be unsightly, and in numerous ways a public annoyance. As the city grows the wires will increase in number, and now, while the change can be made at comparatively small inconvenience, steps should be taken in that direction."

The following item, which evidently must be taken with considerable allowance, appeared in the Springfield, O., *Republic Times*. A thrilling incident occurred at Hughes & Solenberger's, on East Main street, a day or two ago, during the progress of one of the violent storms that continued during the two weeks of bad weather. The telephone had been acting badly all day, sputtering, chattering and rumbling, and creating a good deal of fun among those present, who regarded the electrical disturbance as a huge joke. About 5 o'clock in the evening, just after the electric lights had been turned on, the climax of the whole day's difficulty came, and it was not funny in any degree. The telephone suddenly caught fire and commenced to smoke ominously, at the same time emitting a crackling noise that was not reassuring. The next instant, a swift, intense tongue of fire shot out horizontally from the telephone, licking out four or five feet The crowd fled in terror to the rear of the room. The trouble was caused by the telephone wires crossing with the electric light wires.

The Nebraska Telephone company connects Omaha and South Omaha with sixty-eight Nebraska towns, says a correspondent of the Chicago *Century*. Outside the cities it operates 800 miles of wire. It opened nine new offices during the year. Connections are made with 61 offices of the Iowa Union Telephone company of Iowa. Thus Omaha is directly connected with 117 outside cities. The number of employes in Omaha is 52, and the total number of employes in the state is 184. It is well to remember, however, that as these figures are being constantly increased, they can only be regarded as suggestive. The total number of telephones in use in the state at the present time is 3,518, of which Omaha has 1,261. There are in Omaha 742 miles of wire. In the first six months of this year the number of messages conveyed to outside points was 66,374, and the number of city calls have amounted to an average of about 15,400 per day. There are nine public telephone stations in the city, and the revenue derived from them is considerable. The toll lines of the company have been extended as far west as York and Columbus, and south to Fairbury. The offices of this company in the Ramge block are very elegantly fitted up, and equal in their conveniences to the best in the country. The switchboard used is one which has no superior in the United States. The officers of this enterprising corporation are as follows: S. H. H. Clark, president; J. J. Dickey, vice-president; L. H. Korty, secretary and treasurer; Flemon Drake, general manager, and V. P. Musselman, cashier. The company is spending this year about $35,000 in improvements and extensions, its outlay of last year in the same direction being $30,000.

THE TELEPHONE.

In the United States Circuit court at San Francisco recently the Western Union Telegraph company obtained judgment against J. Christensen for $1,000 damages for cutting wires belonging to plaintiff in Contra Costa county.

Since July last, C. B. Snady, New York state organizer of the Order of Railway Telegraphers, has organized new divisions in Syracuse, Oswego, Watertown, Buffalo, Utica, Binghamton, Elmira and Suspension Bridge, About 1,000 telegraphers have been initiated into the order since July in New York state alone. The whole membership of the order in the United States and Canada, is 17,000.

The Western Union Telegraph company is at last on the floor of the chamber of commerce, says a Minneapolis, Minn., paper. Ever sinte the chamber was organized there has been a fight between the two, and at last the Minneapolis institution has won on every point. When the new building was first occupied, the commission men wanted the Chicago quotations. The Western Union offered to furnish them, but at an exorbitant figure. It also asked regular rates for messages during trading hours. The rates to Duluth were particularly high, and at one time there was talk of the grain men building a line of their own. Then came the North American, and it was hailed with joy by the members of the chamber. An agreement was speedily reached. The company was to have an office on the top floor and furnish the quotations for $2,000 a year. They have rent free and send messages during board hours at reduced rates. For a long time the Western Union has desired to get on the floor, but they would not accede to the demands of the chamber—a rental of $1,500. But at last the great company have been forced to accept the situation, and yesterday they put in an office.

With reference to the recent sad accident in France, *Electricite* for last week laments the absence on railways of the means of countermanding by the use of electricity the signals given to allow trains to pass, if, as happens in some cases, a signal has been wrongly given or a mistake is afterward discovered, so that an otherwise unavoidable frightful accident may be averted. The case was put very strongly in a communication to the Kingston papers at the time of the Hampton Wick disaster, says the London *Electrical Engineer*. "One of the saddest points about the whole accident is the personal attitude of the signalman in such cases For years and years he has gone on with his duty faithfully and conscientiously, making no mistake, till one day, under pressure of extra work, he makes a slip; he discovers it, may be, as in this case immediately, and the position of signalman may be better imagined than described. He has set the points wrong, sent the train on its deadly journey, and in a moment realizes the whole horror of the situation. What is he do? There is no means of communicating to the engine after it has passed the signal, or of stopping the oncoming train. He has made a mistake, and what is more, has no power, even if he finds it out before the accident, to prevent it happening. Very few of us are under such conditions in life, that by a single slip in our ordinary business we may launch numbers of our fellow men into eternity, without the possibility of retracting our error if immediately found out Imagine for a moment what the state of mind would be of an ordinary clerk or secretary, if every letter he wrote carried with it the certainty that a mistake in the address might by some means hurl hundreds of men to destruction, and that there was an absolute veto on the part of the post office for any alteration of such mistake, and no possibility of telegraphing to the person the letter was addressed to. A signalman *is* in such a position, and may be tried for manslaughter for such a slip in his business practice. One of the most terrible and sensational railway accidents that ever happened occurred under similar conditions in these respects to those of the present accident, but with far more disastrous results. Who does not remember reading with horror the description of the accident at Monte Carlo? The train being dispatched on the single line by some oversight of the station master, while the train due shortly in the station was being dispatched on the same line in the opposite direction. The station master realized his error, but there were no signals to alter between the two trains He rushed hither and thither, rung, for a futile resource, all the bells in the station, and yelled in his despair to make the engine driver perceive his danger—but with no avail. And the whole number of officials and passengers on that station stood with awful dread watching the two distant white puffs of smoke getting nearer and nearer round the curve on the rocky shore, until they shaded their eyes with anguish when the two trains met and went over the precipice in blinding steam. May not the public ask, Is there no resource of science which will prevent such irremediable mistakes happening in the future? Accidents will happen; but when there is, as there sometimes is, considerable time after the discovery of the error, are there no means to stop the train at any part of its course?" The writer goes on to point out the security which might be obtained from this class of accidents by the adoption of some system of induction telegraphing to trains in motion as in use in America, or of telephoning by means of a Ruhmkorff coil in the guard's van, as experimentally tried in France. It is obviously the duty of railway or other companies whose dividends are earned by taking charge of human life to be fully abreast in practice of the latest development of scientific research for the safe guarding of life, and the remarks of the *Electricite* on the recent accident in France add point to this by demanding that some better means ought to be provided for remedying possible errors than by the futile ringing of the station bell, or the insane knocking of the station master's head against the wall in anguish over a fatal and irremediable mistake.

Personal Paragraphs.

Paul Seiler has retired from the management of the California Electrical works of San Francisco, and John I. Sabin is now vice-president and general manager.

The many friends of Professor F. B. Badt, whose return to Chicago was briefly noticed last week, will be gratified to learn that he has decided to remain permanently in Chicago, and has already entered upon an engagement with the Western Electric company.

Miscellaneous Notes.

The St. Louis, Mo., Electric Battery Manufacturing company has increased its capital stock from $2,500 to $50,000.

At a recent meeting of the Grand Rapids, Mich., Academy of Medicine, Dr. W. F. Hoyt read a paper on surgical electricity.

Tests of the electric brake invented by Edward Backus of Rochester, N. Y., indicate, it is said, that the invention will be of practical value.

The Shaw Electric Crossing & Advance Signal company of East St. Louis, Ill., has been incorporated; capital stock, $1,000,000; incorporators, W. P. Shaw, A. X. Mackey and John B. Livingston.

The Pacific Edison Phonograph company of San Francisco has been incorporated. The directors are John I. Sabin, Louis Glass, L. H. Jacobi, John A. Mallon and Robert T. Stevens. The capital stock is $720,000.

The Link Belt Machinery company of Chicago has begun the erection of its new foundry to be located on its five and a half acre tract at Thirty-ninth street and Stewart avenue, Chicago. The structure will be 286 feet long by 87 feet wide, and will probably be completed before spring.

At a recent meeting of the Toledo, O., city council an ordinance to confiscate all top cross arms of telephone and telegraph poles to the use of the city, and to require that hereafter all top cross arms shall be turned over to the city for exclusive use, was passed. A fine of $100 goes with each violation of this ordinance.

The Nebraska Phonograph company has been incorporated. The incorporators are Frank Murphy, J. O. Phillippi, Frank Drake, Hamilton S. Wicks, Simon Ott and George E. Tewksbury. The general offices of the company will be located in Omaha. The company will operate in Nebraska, Iowa, and in the territories of Dakota, Montana and Wyoming. The capital stock of the company is set at $625,000.

A curious phenomenon was recently related by M. D'Arsonval before the French Academy of Medicine, says the *Medical Press*. After gazing for a few seconds on an arc light of intense brilliancy, he suddenly became deaf, and remained so for nearly an hour and a half. Surprised and somewhat alarmed in the first instance, but reassured by the disappearance of the symptoms, he repeated the experiment with the same result. When only one eye was exposed to the light, no very marked effect was produced.

A dispatch of November 9th says: The most phenomenal snowstorm that ever occurred in Northern Kansas began this morning, and has continued furiously all day. The trains are all delayed and the telegraph wires are prostrated in all directions, with the exception of one line to Kansas City. In Atchison over 200 telephone lines are broken and so tangled up with electric light wires that the electric light works have been suspended to prevent accidents. The extent of the damage cannot be ascertained owing to the suspension of telegraphic communication.

William Burke, electrician at the gas works at Decatur, Ill., has invented a new fire alarm system. These boxes have a glass front which must be broken before an alarm can be given. In this way false alarms are guarded against; when it is wished to give an alarm the glass is broken and any one by reaching in can turn a little lever which immediately sounds the alarm at the separate headquarters of the firemen. The alarm is sounded five distinct times, giving the number of the station from which the alarm has been sent and recording it on a tape of paper. The council of Decatur has investigated the system with a view of adopting it in that city. The telephone system is now employed.

Some months ago an Electrical Railroad Scale company desired to locate in Akron, and the matter was given some attention by the board of trade, says an Akron, O., paper. At that time satisfactory arrangements could not be made. Of late this company has been putting in position several of its scales along the line of the Grand Trunk in Michigan, and has recently written well-known citizens of Akron that as soon as it completes its work in Michigan it would like to continue negotiations to come here. It would require considerable capital to put this business upon a successful running basis, yet the offer the company makes is a liberal one, and well worthy of consideration.

Business Mention.

The Chicago office and salesroom of the "C. & C." Electric Motor company have been removed to the Edison building, 139 and 141 Adams street.

Chas. A. Schieren & Co. report sales of their electric perforated belting to twelve different electric light companies during the past month. The demand for this article is steadily increasing.

The Western Electric company of Chicago has received the following letter, dated November 9th, signed by James Allison, president of the Cincinnati exposition, and J. M. Blair, chairman of the building committee and electric light department: "We have been using your arc light system at our Centennial exposition from July 4th up to date, about four months, and it has been entirely satisfactory, having run from the start to finish, without interruption. The

light is steady, brilliant, and of an agreeable color. We do not hesitate to state that your arc light was a complete success, and highly satisfactory."

The experiments that have been conducted by the Westinghouse Electric company of Pittsburgh, Pa., during the last three months with the Tesla motors have been of a most satisfactory character. A form has been perfected that will operate on the existing alternating circuits for the running of fans and other light machinery, and also the large motors for street car purposes and power purposes generally have been brought to a high degree of perfection and efficiency. In street car work the Tesla motor has great advantages over the motors that have heretofore been in use. These motors are usually placed under the car, and are liable to be damaged by water and dust; and having expensive commutators and brushes, the armatures of the machines are frequently burned out, making the expense of maintenance excessive. The Tesla motors having no brushes or commutators, can be constructed so that even if covered with mud and water no possible danger can occur. The manufacture of the Shallenberger meter for measuring the supply of light, is being pushed. Already 100 meters per week are being turned out, and the required machinery for 300 per week is being obtained, while the demand for the meters is greatly in excess of the present supply. These meters will measure the currents for the motors and for lighting, and will give to all users of light the advantage of the electric light and motors for power purposes at rates in competition with gas for light, and at low rates for the motor service. Already the Westinghouse Electric company has contracted for the supplying of plants to 122 stations, thirty-eight of which have ordered machinery, increasing their plants since starting, some of the stations having made successively four increases. During the month of October the apparatus contracted for amounted to 48,000 lights, 25,000 of which are for use abroad. The increase in business has obliged some of the departments of the company to be run until 10 o'clock at night.

By reference to the new illustrated catalogue issued by the Ashton Valve company, a fine specimen of the typographical art, the wide range of their product is displayed, says the Boston *Daily Advertiser*. It covers every known variety of pop safety valves for stationary, marine and locomotive boilers; hydraulic valves for pumping machinery, relief valves for steam pumps, and a range of special valves for special purposes, to meet all the requirements of this department of steam engineering. The past fifteen years has witnessed a great advance in the efficiency and variety of the appliances for the use, direction and control of steam. The marvelous ingenuity and perfection of mechanical skill in these various lines is everywhere recognized, but in none has it reached a more advanced stage than in the product of the Ashton Valve company, which now stands unrivaled at the head of its art in this particular department. The temptations of competition in prices have never led to the least departure from their standard, or to the delivery to their customers of anything less than the best that can be made. An Ashton valve, the world over, is known for what it is, of undeviating quality, and this is now so widely recognized that whether on the great railroad lines or in the large manufacturing centers, on the lakes or the seaboard, their valves are sought for and applied simply on their merits, and on the reputation their product has won for itself everywhere. The works of this company are situated at 271 Franklin street in this city, and are perfectly adapted to the necessities of their business. The equipment of machinery and of special tools is unique. The latter were especially designed and constructed for them, each having the accuracy of a template, and performing the function of the finest gun machinery, which makes the parts interchangeable like the parts of a Waltham watch. This gives great accuracy in construction and efficiency in operation to their valves. They are in use in every state and territory. They have been adopted by the great trunk lines for locomotives, by the government in its approval of them for steam vessels, and no steam plant is considered complete anywhere that is not equipped with the pop valve, which, of their make, is equal to the best now made in the world.

Electrical Patents.

Issued Nov. 6 1888.

392,213. Transformation and Distribution of Electric Energy. William J. McElroy, Pittsburgh, Pa.

The distribution is accomplished by means of condensers, the method consisting in charging one member of a condenser, thereby inducing potential on the other member and finally discharging the latter at such changed potential.

392,228. Mast Arm for Electric Lights. Charles W. Russell, Providence, R. I.

392,230. Electric Regulating and Hand-Setting Mechanism for clocks. William S. Scales, Somerville, Mass.

The invention comprises an electric circuit containing several clocks, each provided with a regulating device for the regulating member thereof, of a circuit controlling device for rendering the said circuit operative to permit an impulse to be transmitted to the several clocks to be regulated, and to transmit the impulse, and a master clock for effecting the operation of the said controlling device.

392,244 Secondary Battery. Hugo Walter, Cincinnati.

The electrodes are composed solely of solid crushed or broken carbon, sufficient space being given for the circulation of the electrolyte in and around the pieces of said broken carbon.

392,248. Police Alarm System. John C. Wilson, Boston, Mass.

The system includes two or more metallic or signaling circuits having ground branches including telephones, a common ground branch for all the circuits, which includes a telephone, and a rotary switch operated by the movement of a pointer over a suitable dial or index for connecting the common ground branch with any one of the said signal circuits.

392,301. Telephonic Circuit. Robert M. Bailey, Williamsport.

The object of the invention is to arrange the circuits and connections so that each telephone station (irrespective of the number that may be connected with the circuit) shall or may during the transmission of speech have at its disposal an individual, clear and unincumbered telephone line with absolutely no electro magnets intervening between the station itself and the central station or between any two sub-stations of the same line which may be carrying on conversation. Claim 5 reads as follows:—"An electric telephone circuit comprising a main closed circuit connecting with a number of telephone stations having telephones in grounded branches, said circuit including the signaling magnets thereof for the purpose of sending and receiving signals, combined with an independent talking circuit connecting at one end with the closed circuit at a point between the first two stations thereof and extending therefrom to all stations, whereby the several stations of a multiple station circuit are each practically provided, while conversing, with an independent and unencumbered talking circuit."

392,326. Telephone Switch-board. Claude C Gould, Batavia, N. Y.

The first claim follows: "The combination, with the main line and a plug connected therewith, of a hand contact adapted to be applied to said plug, a generator, a stationary contact point connected with said generator, and a movable contact point connected with the hand contact and adapted to engage with the stationary contact point, whereby the generator is connected with the hand contact."

392,370. Regulator for Alternating Current Generators. Robert P. Sellon and William M Mordey, Victoria Works, Belvedere Road, County of Surrey, England.

392,385. Electroplated Coil for Electrical Measuring Instruments. Edward Weston, Newark, N. J.

The coil is wholly covered on its exterior with electro deposited dimagnetic metal.

392,386. Electrical Measuring Apparatus. Edward Weston, Newark, N. J.

The invention consists essentially in a magnet, an electrical conductor in coil or loop form, supported and vibrating in the field of said magnet, a resilient body placed between said coil and an abutment and an electrical resistance in multiple arc circuit with the terminals of said coil.

392,387. Electrical Measuring Apparatus. Edward Weston, Newark, N. J.

The tenth of the twenty claims follows: "A magnet, an electrical conductor in coil or loop form supported and vibrating in the field of force of said magnet, and a spring interposed between said coil and an adjustable abutment."

392,393. Arc Lamp. John C. Young, Newark, N. J.

The eighth claim is as follows: "The combination of the feed-controlling magnet and its armature with a clutch lever pivoted to the armature, and a trip lever, the said trip lever being interposed between the armature and another point of the clutch and pivoted to an independent support and swiveled to the armature at a point between its pivot and its free end.

392,400. Electric Discharge Device. Reginald Belfield, Pittsburgh, Pa.

The invention consists in equipping the generator with discharge points which are supported by, but insulated from the frame of the generator and directed toward the belt wheel. These points are connected electrically with the earth. A harmless discharge may take place at all times from the pulley to the points, and thus to the earth or to the driving engine.

392,403. Switch-board for Telephone Exchanges. Francis Blake, Weston, Mass.

The claim reads: "In a switch board for a telephone exchange, the combination, with the line wires, of, first, the distributing board provided with terminals and grounded annunciators, one of each for each line wire; second, connecting tables through which the said line wires or subscribers' lines pass in groups to their respective said terminals and annunciators at the said distributing board, there being in each of said lines a spring jack at that connecting table through which the line thus passes, and, third, connecting strips between said distributing board and each of said connecting tables, each of said strips being provided with a connecting cord or similar terminal at each end, and also with an annunciator at its respective connecting table."

392,437. Electric Meter. Philip Lange, Pittsburgh, Pa.

The invention relates to suitable means being provided for periodically placing an ammeter in condition to be operated by the current traversing it and at the same moment storing up a force sufficient to move the recording device a distance corresponding to and dependent upon the amperes at that time being used.

392,438. Combined Electric Meter and Electric Clock System Philip Lange, Pittsburgh, Pa.

The eighth claim reads: "The combination, with an electric meter and an electro-magnet for periodically operating the same, of an indicating movement actuated each time the meter is operated, thereby registering the number of times the meter is operated."

392,439. Electric Meter. Philip Lange, Pittsburgh, Pa

The invention consists in applying to a suitable apparatus responding to variations in the current consumed a device serving to periodically give a registration or operate a registering mechanism to a degree dependent upon the position of the apparatus, and thus upon the current consumed.

392,440. Electric Gas-Lighter. Joseph H. Lehman, Philadelphia, Pa.

392,443. Magneto-Signaling Apparatus. Malcolm W. Long, Harrisburg, Pa.

The fifth claim is given: "In a railway signal, the combination of a signal and an electric motor for actuating the same, a magneto generator provided with manual operating devices and located at a distance from the signal, suitable conductors connecting the motor and generator, an electric indicator located adjacent to the generator, and an automatic switch connected with the motor and acting, as described, to establish a circuit through the indicator when the signal reaches its limit of movement, whereby the generator is rendered available, first, to positively move the signal, and, second, to actuate the indicator to show the position of the signal."

392,444. Railway Signal. Malcolm W. Long, Harrisburg, Pa.

Claim 1 reads: "As a means of automatically setting a signal alternately to 'danger' and to 'safety' by the action of moving trains, the combination of a visual signal, an electric motor for operating the same, two widely separated magneto generators, each provided with track connections to be actuated by passing trains, conductors leading from the generators to the signal-motor, and an automatic switch connected with the signal and acting to connect the motor with the two generator circuits alternately as the signal is changed from one position to another."

392,470. Operating Alternate Current Motors. William Stanley, jr., Great Barrington, Mass.

The method claimed consists in transmitting alternating electric currents through the armature, and in generating continuous electric currents in an independent circuit by the movement of the armature and creating a field for the armature by such continuous currents.

392,471. Alternate Current Electric Motor. William Stanley, jr., Great Barrington, Mass

This invention relates to the construction of motors designed to be driven by alternating electric currents.

392,476. Reflecting Galvanometer. Edward Weston, Newark, N. J.

The invention consists in the arrangement of the coils and devices for supporting the same in the standard, in the tubular core, and arrangement of the mirror and needle therein, and in the controlling magnet in disk form, together with other combinations and sub-combinations.

392,477. Galvanometer. Edward Weston, Newark, N. J.

The second claim is as follows: "In an electrical measuring instrument, a standard having a seat or shell, two spools or bobbins carrying coils and adapted to enter said seat, and means for detachably connecting said spools one to the other."

392,478. Galvanometer. Edward Weston, Newark, N. J.

The invention relates to galvanometers wherein are contained a magnet and suspending fiber, the magnet being provided with a mirror from which a beam of light is reflected upon a suitable scale.

392,490. Commutator Bar for Dynamo Electric Machines. Charles E. Billings, Hartford, Conn.

392,513. System of Incandescent Lighting. Charles Heisler, St Louis, Mo.

The invention includes, in a system of incandescent lighting, a main circuit supplied from an alternating current machine and a transformer or induction coil for supplying a branch circuit for indirect lighting. It includes also, in connection with a transformer for the branch circuit, a regulator for the coils of the transformer, and a mechanical power device operated by the switching in of the first lamp of the branch circuit, said power device being in connection with the regulator, which is thus automatically operated to connect or disconnect one or more of the coils of the transformer.

Claim 1 is as follows: "A system of incandescent lighting consists of a main circuit supplied from an alternating current machine, a transformer in said main circuit, an induced circuit extending from said transformer, a regulator in connection with the main and induced circuits, a power device in connection with the shaft of the regulator for operating the same, and means for automatically releasing the power device on the switching in of the first lamp."

392,520. Arc Light Carbon. James J. McTighe, Freeport, Pa.

The carbon pencils are formed by mixing granulated natural gas hard carbon, with viscous hydro carbon, then molding and pressing them into shape, and then baking in an atmosphere of natural gas.

392,573. Method of Making Electrodes for Secondary Batteries. Charles H. Thompson, Detroit, Mich.

Claim 2 follows: "The method of producing an electrode for a secondary battery, which consists in casting or molding a highly porous or cellular support with a solid terminal integral with the body thereof, then coating the support with active material or pressing it into the pores or cells thereof."

392,574. Electrode for Secondary Batteries. Charles H. Thompson, Detroit, Mich.

The 1st claim reads: "A support for an electrode, consisting of a body having tortuous ducts throughout, forming a porous mass and a solid terminal integral with the body."

392,577. System of Electric Meters. Alexander Wurts, Pittsburgh, Pa.

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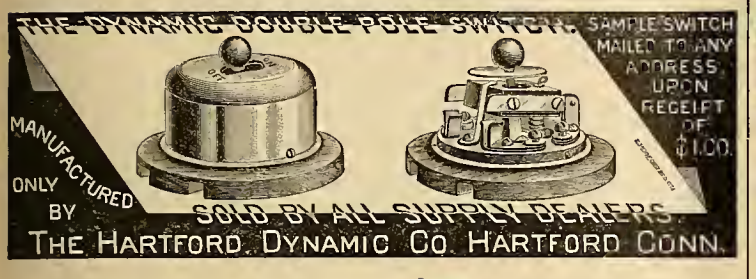

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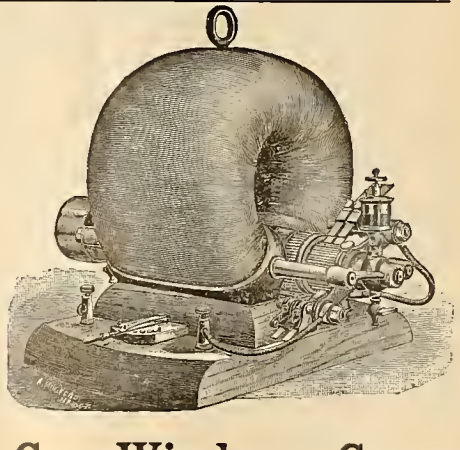

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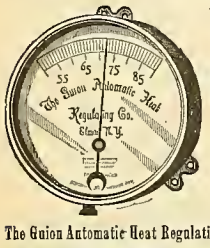

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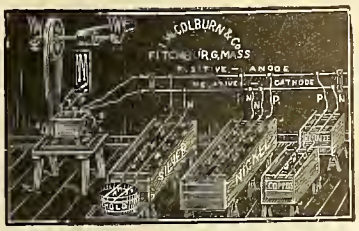

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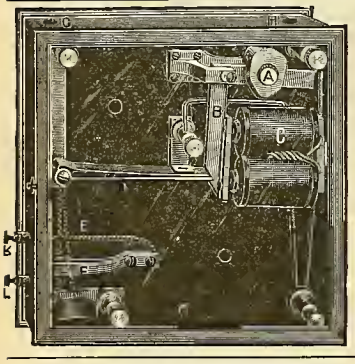

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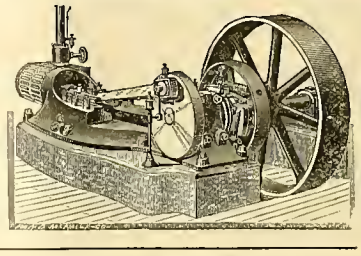

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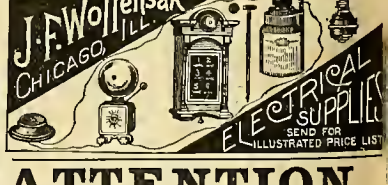

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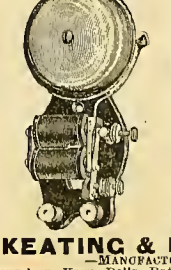

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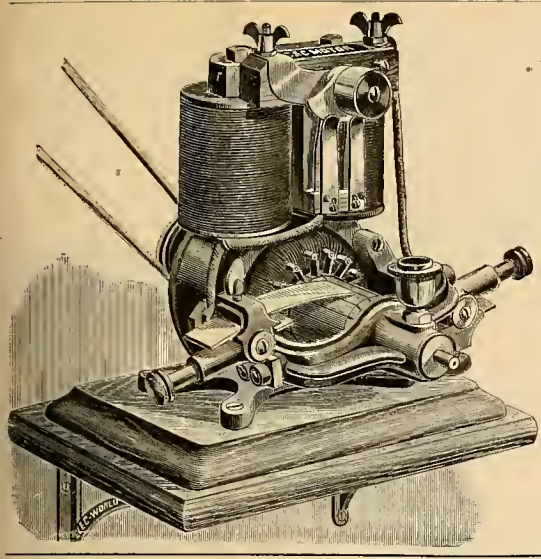

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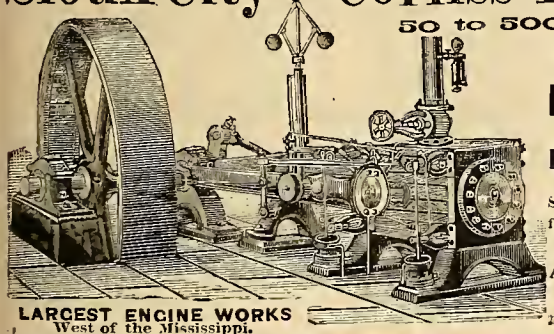

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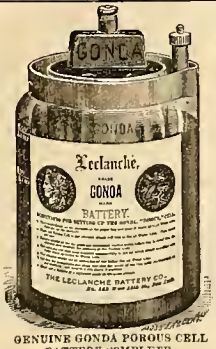

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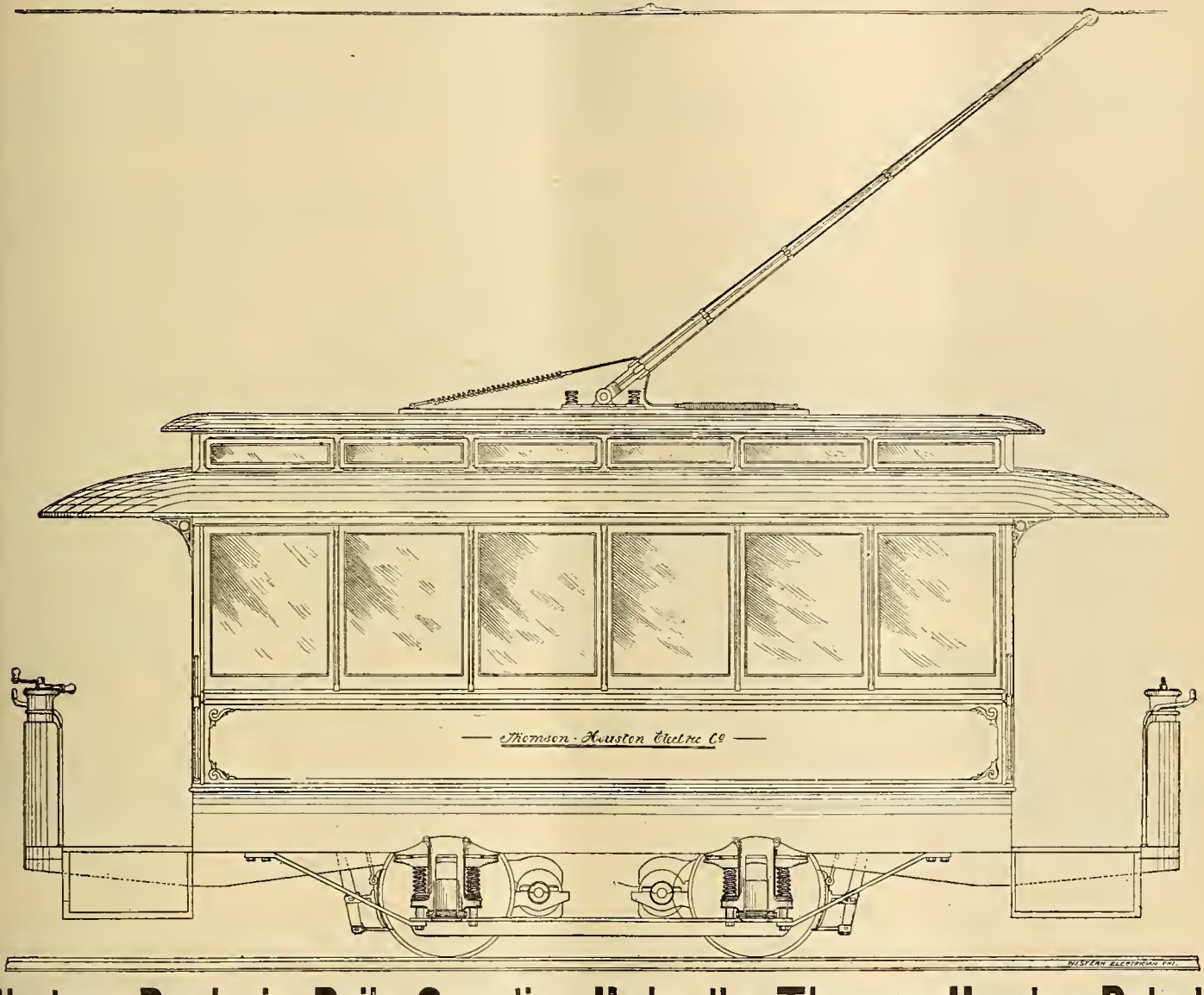

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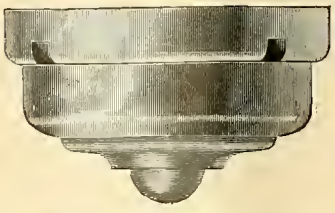

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The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers ; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and inoperative on account of their susceptibility to the all-pervading magnetic influence.

AMERICAN WATCH CO.,
Waltham, Mass.

GILES BROS. & CO. 103 State Street, CHICAGO.

THE LIST OF SALES OF THE

Westinghouse Engines: Compound, Standard and Junior,

FOR THE MONTH OF OCTOBER, 1888,

Is too long to publish *in extenso* as an Advertisement. Orders were received on eighteen working days, the five heaviest days yielding respectively, 16, 11, 10, 8, and 7 ENGINES EACH.

TOTAL, 86 ENGINES, AGGREGATING 3310 H. P.

Sales for August, September and October were over 200 ENGINES of all types, aggregating nearly *10,000 HORSE POWER*. Note in connection with the above exhibit, that our current advertising expenses for 1888 are about one-half that of any preceding year.

WHY IS IT?

The Woodbury

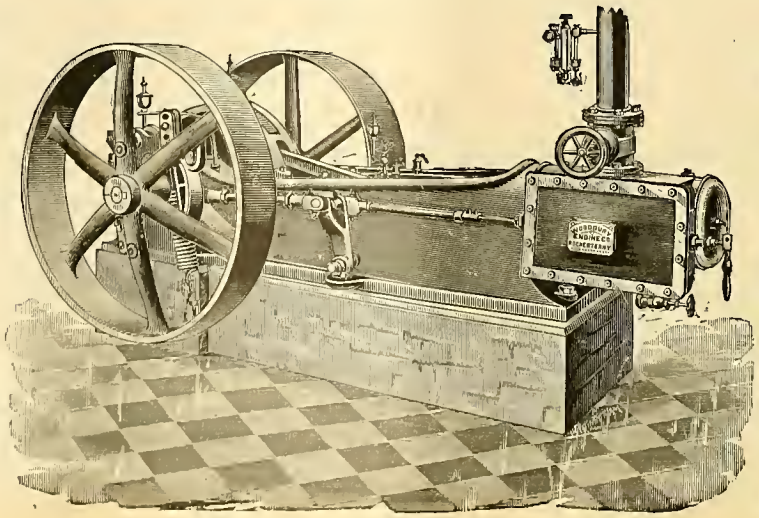
AUTOMATIC

Cut-Off High Speed

ENGINE.

—— MANUFACTURED BY ——

WOODBURY ENGINE COMPANY.



ALSO BUILDERS OF

PLAIN SLIDE VALVE

—AND—

Double Valve Medium Speed

AUTOMATIC

Cut-Off Engines

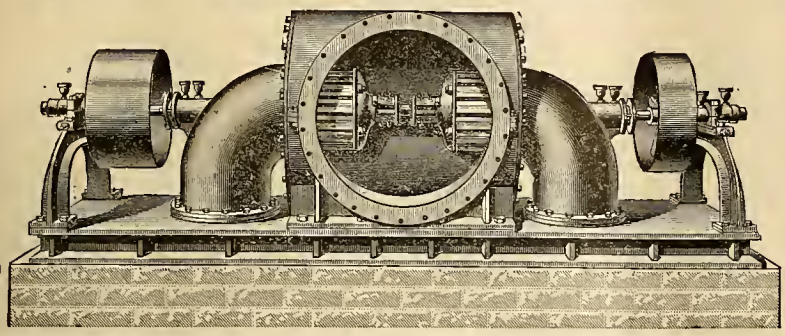
—AND—

TUBULAR BOILERS.

Address the Manufacturers at

652 Mill Street, ROCHESTER, N. Y.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft, with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

WM. GARRETT, President. CHAS. S. BRITTON, Vice-Pres't. H. E. HAYES, Treasurer. C. L. RODMAN, Acting Sec'y.

THE GLOBE CARBON CO., CLEVELAND, OHIO.

CARBONS FOR ELECTRIC LIGHTS, BATTERIES, ETC.

Office and Works, - - - - C. & P. R. R. EUCLID STATION.

The Brush Electric Company

—OF—

CLEVELAND, OHIO.

MANUFACTURERS OF

BRUSH ARC

—AND—

Incandescence Electric Lighting

APPARATUS.

ELECTRIC MOTORS!

CARBONS FOR ARC LAMPS, ETC.

CHICAGO OFFICE,
No. 180 Washington Street,
ALEXANDER KEMPT,
Special Agent.

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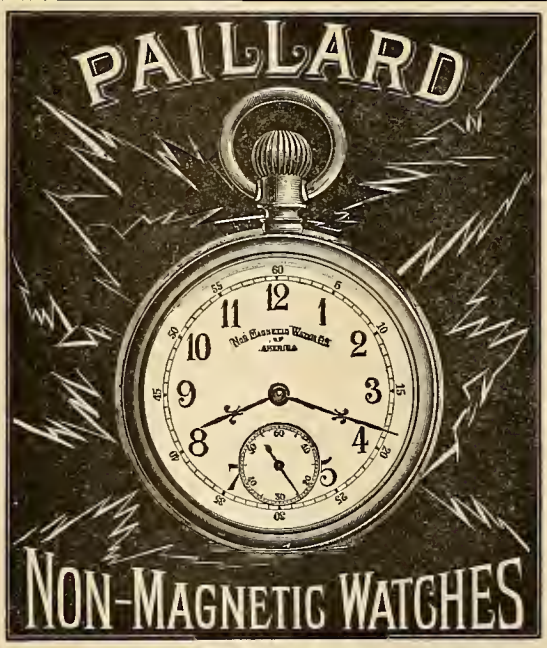
Special Agent



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—BY—

Thomas A. Edison, Elihu Thomson, N. S. Possons, Edwin J. Houston,

AND SCORES OF LEADING ELECTRICIANS.

FOR SALE BY ALL JEWELERS.

Send for Pamphlet "ARE YOU POSTED?" to

NON-MAGNETIC WATCH CO.,

177-179 Broadway, N. Y.

DYNAMO TENDERS' HAND-BOOK

By B. F. BADT.

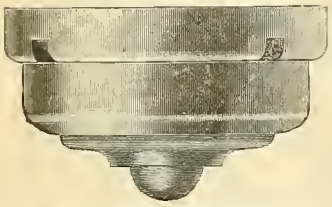
100 pages; 70 illustrations; flexible cloth binding; size of type page, 6 x 3 inches. Designed for Dynamo Tenders and Linemen, Stationary and Marine Engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

Price, Postage Prepaid to any address in the United States or Canada, $1.00.

Address ELECTRICIAN PUBLISHING COMPANY,

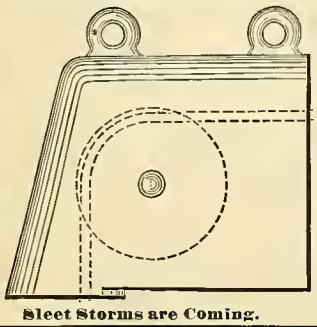
6 LAKESIDE BUILDING, CHICAGO.

The Stoddard Combined Rosette AND CUT-OUT.



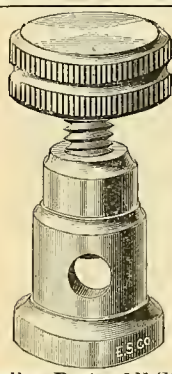
The Rosette and Cord entirely removable for replacing Fuses.

SLEET PROOF PULLEY.



Sleet Storms are Coming.

DYNAMO TERMINAL.



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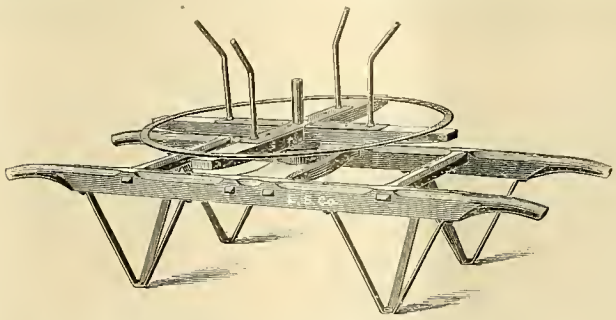
CARBON CASE.

YOU WANT ONE!



Combination Pay-Out Reel.

WE SELL EVERYTHING REQUIRED FOR THE CONSTRUCTION, OPERATION OR EXTENSION OF *Electric Light Plants.*

INSULATING TAPE.

WE CARRY

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White Grimshaw,
Black Grimshaw,
White Rubber,
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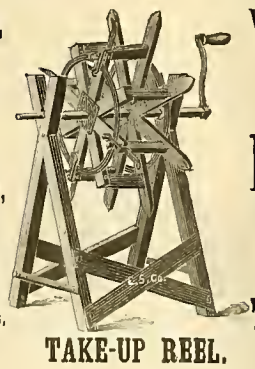

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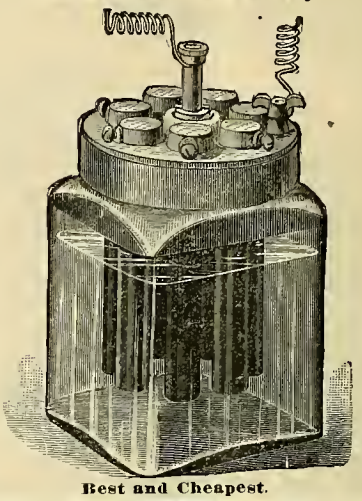
WE MAKE A Specialty of

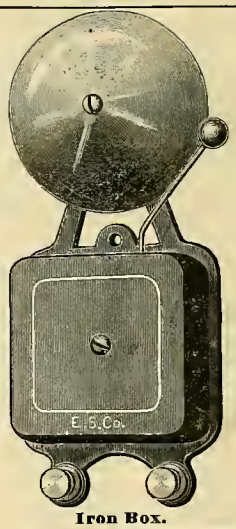
ELECTRIC LIGHT TOOLS

The Diamond Carbon Battery.



Best and Cheapest.

HANDSOME BRONZE PUSH.
Moderate Price.



Iron Box.

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THE ELECTRICAL SUPPLY CO.

171 RANDOLPH STREET,

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FACTORIES:
ANSONIA, CONN.

BRANCH OFFICE:
505 Delaware St., KANSAS CITY, MO.

A PRACTICAL ILLUSTRATION!

OF THE

WATERHOUSE SYSTEM

OF ARC LIGHTING.

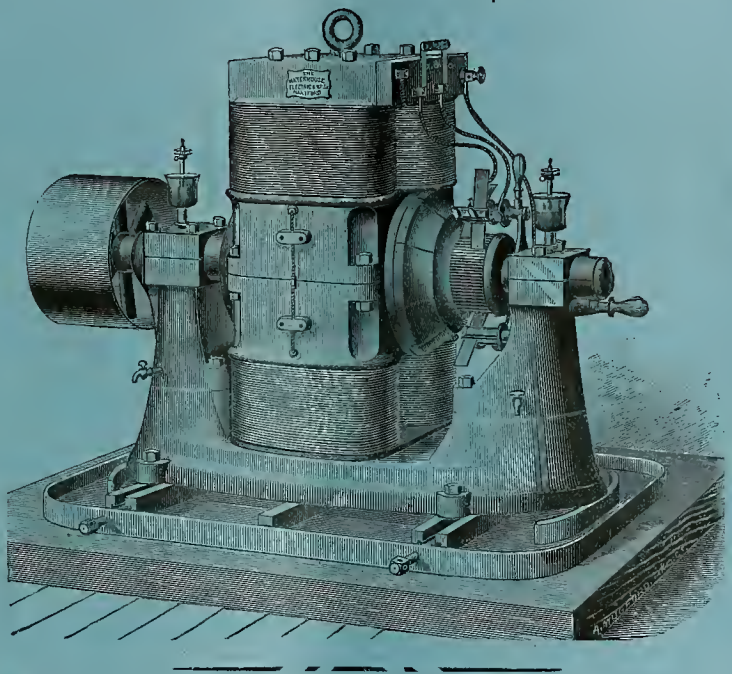
AWARDED

GOLD MEDAL

Mechanics' Fair,

BOSTON,

DECEMBER, 1887.



AWARDED

GOLD MEDAL

AND

Two Silver Medals

CENTENNIAL EXPOSITION

CINCINNATI,

OCTOBER, 1888

READ THIS LETTER.

HARTFORD, CONN., October 15, 1888.

THE WATERHOUSE ELECTRIC AND MANUFACTURING CO.

GENTLEMEN:—In reply to your inquiry would say, on last March we purchased our first dynamo (35 lighter) and having 5 arc lights ordered, that number were placed on the line. The dynamo was running at that time 100 revolutions above speed, but the regulator maintained the standard current and the machine was perfectly cool, very little current passing around the field magnets. Our customers were pleased with the lights, and many have stated to us that they would not change for those of the old company, which the Waterhouse displaced.

The satiafaction in your system to those operating it is this: We do not have to burn more lights than are actually required. As an example, on the 35 light circuit of the machine above mentioned we start when the inside lights are wanted; the store outside lights being turned off. Our trimmer turns on the outside lights when wanted, and the full number burn. At intervals during the evening up to 10: P. M. our customers close their stores, turn out their inside lights and leave their outside lights burning to illuminate the windows, and on the circuit from 10: to 12: P. M. we have an average of five lights, the balance being turned off. This has been done every night since last March, and the fact is that we do not know at the station when the lights are turned off, because there is no over production of current. If only one light were required to run on that circuit we should not healtate to operate it on the 35 light dynamo, because the Waterhouse regulator will regulate to one light.

The repreaentations you make of your syatem are fully carried out in practice, not only in the matter of regulation but also in the economy of power and steady light. You can refer to us at any time. Yours truly,

THE HARTFORD LIGHT & POWER CO.,
DAVID HENNEY, President.

THE BEST ARC LIGHT IN THE WORLD!

IS MANUFACTURED BY

THE WATERHOUSE ELECTRIC & MFG. CO.,

HARTFORD, CONN.

SEND FOR CATALOGUE.

FORT WAYNE JENNEY ELECTRIC LIGHT COMPANY,

Fort Wayne, Indiana.

Manufacturers of the

SLATTERY INDUCTION SYSTEM

—OF—

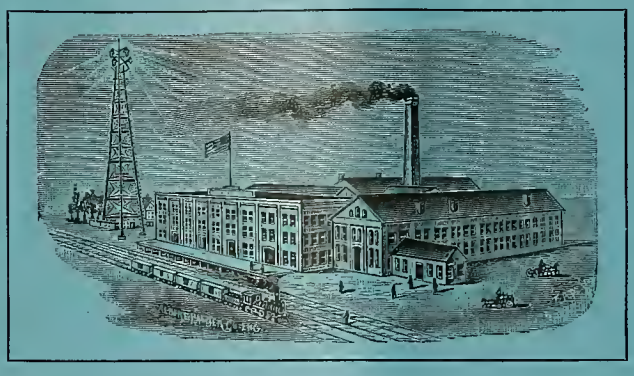
INCANDESCENT LIGHTING,

—AND THE—

JENNEY SYSTEM

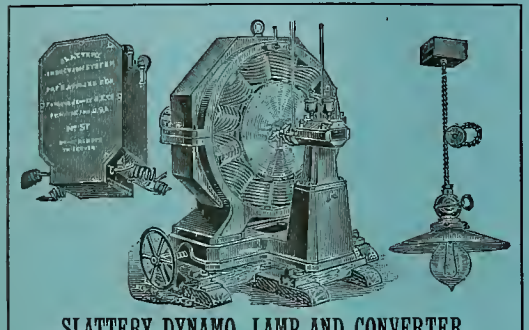
—OF—

ARC LIGHTING.



The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12--16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.



SLATTERY DYNAMO, LAMP AND CONVERTER.

CORRESPONDENCE SOLICITED.

JENNEY ARC DYNAMO AND LAMPS.

MAIN OFFICE AND WORKS, FORT WAYNE, IND.

CHICAGO OFFICE, 185 Dearborn St., First Floor, W. J. BUCKLEY, Manager.

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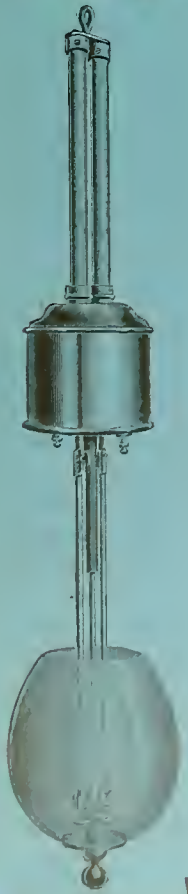
NEW YORK OFFICE, 242, 244 EAST 122d STREET.

PHILADELPHIA OFFICE, 26 N. Seventh Street, G. A. WILBUR, Manager.

CITY OF MEXICO OFFICE, F. Adams, Successor.

VAN DEPOELE ELECTRIC LIGHT SYSTEM.



D. H. FERGUSON, Vice-President. GEO. L. WOODRUFF, Treasurer.

F. L. WOODRUFF, President.

OFFICE OF SECRETARY

Forest City Electric Light and Power Co.

Flora E. Phillips, Sec'y.

STATION: NO. 123 NORTH MADISON STREET, EAST SIDE.

Rockford, Ill. May 18th, 1888.

RECEIVED MAY 19 1888 Ans'd

Van Depoele Elec. Mfg. Co.,
Chicago, Ill.

Gentlemen:

Yours of the 30th ult. at hand. We have been using the Van Depoele system of arc lighting for about two years, with entire satisfaction to ourselves and customers. We have two machines of thirty light capacity which give us for 7200 candle power, and more than we require to run our factory, which is brightly and steadily lighted. We take pleasure in recommending the Van Depoele System of lighting to anyone in need of a first class and reliable light.

Very Respectfully Yours,

FOREST CITY ELECTRIC LIGHT & POWER CO.,
per [illegible]

Manufactured and for Sale only by **VAN DEPOELE ELECTRIC MANUFACTURING CO.,** 15 17, 19 & 21 NORTH CLINTON ST., **CHICAGO, ILL.**

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. III. CHICAGO, NOVEMBER 24, 1888. No. 21

PHŒNIX GLASS COMPANY,

—MANUFACTURERS OF—

Electric Light Globes, Shades,

—ETC.—

SEND FOR CATALOGUE AND PRICE LIST.

729 Broadway, New York.

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Standard Underground Cable Company,

General Offices, No. 708 PENN. AVE., PITTSBURGH, PA.

Branch Offices: { New York, Telephone Building, Cortlandt Street, G. L. Wiley, Manager. Chicago, 139 East Madison Street, F. E. Degenhardt, Manager.

MANUFACTURERS OF

The Waring Anti-Induction and Bunched Cables

For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial. Light Leaded Cables for House Use Weather-proof Line Wire, Underwriters', Annunciator and Office Wire. Six years of uniform Success enable us to guarantee our Cables.

DAY'S KERITE INSULATION.

The acknowledged Standard for durable and high Insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power. Telegraph and Telephone. Railway and all other Branches of Signaling.

All Sizes *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use, Concealed Wiring in all Locations.

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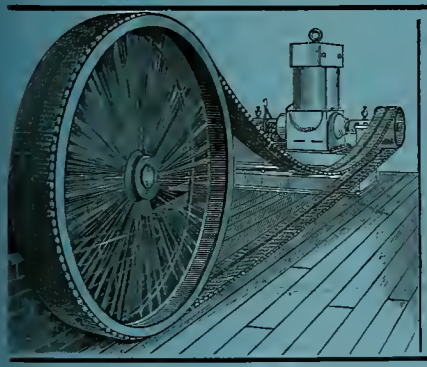

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SPECIAL DYNAMO BELTING.

46 and 48 Ferry St. and 72 Cliff St. NEW YORK.

DUST PROOF BELLS

Superior to All Others.

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The CALLENDER INSULATING and WATERPROOFING COMPANY,

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ELECTRIC LIGHT WIRES OF ALL SIZES A SPECIALTY.

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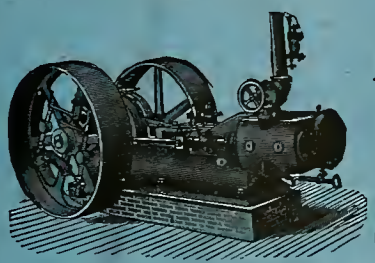

Builders of High Grade Self-Contained

Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.

WESTERN OFFICE AND WAREROOMS:

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ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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DANIEL W. MARMON, President. ADDISON H. NORDYKE, Vice-President.

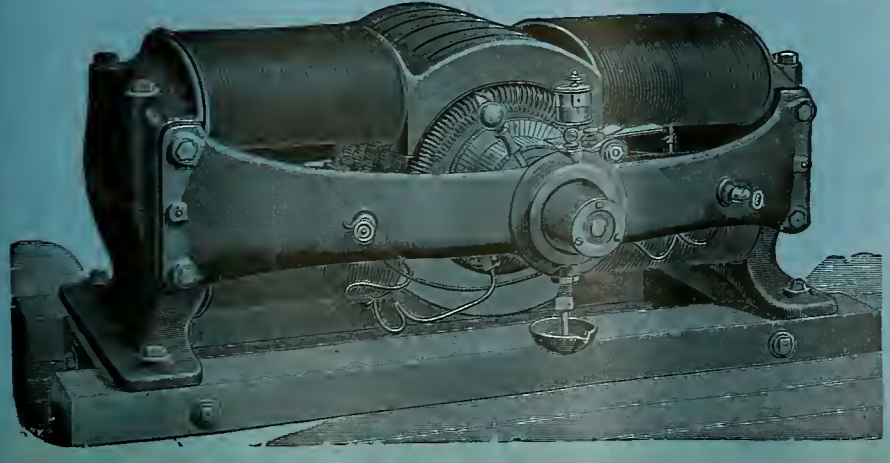
CHARLES D. JENNEY, Electrician.

BRAINARD ROBISON, Secretary. AMOS K. HOLLOWELL, Treasurer.

JENNEY ELECTRIC COMPANY,

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp & Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

☞ SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM. ☜

OFFICE AND WORKS:

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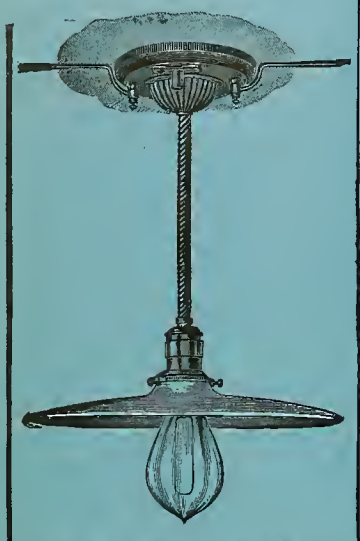
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



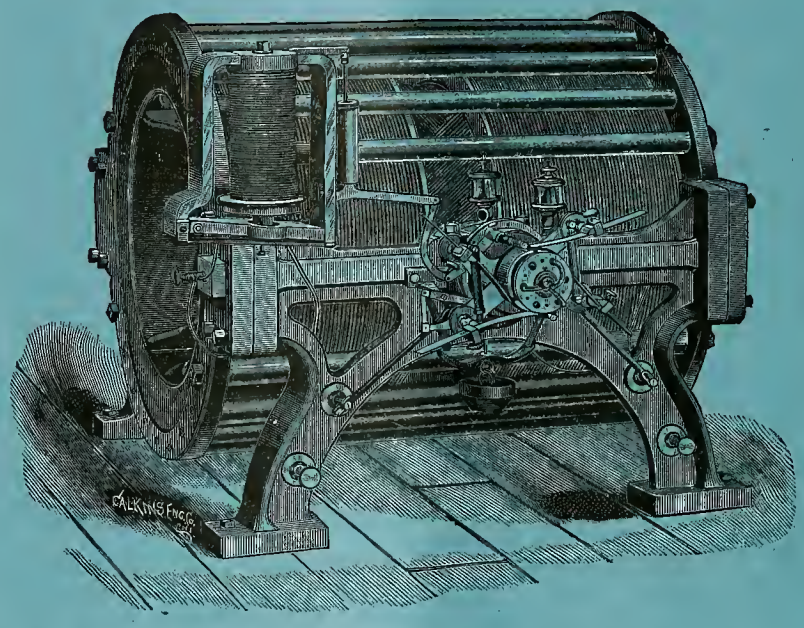
SERIES LAMPS

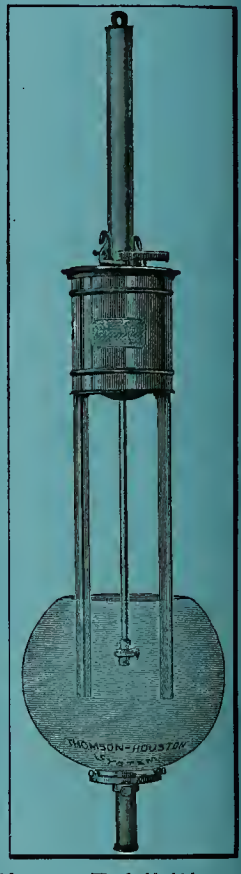
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883.
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



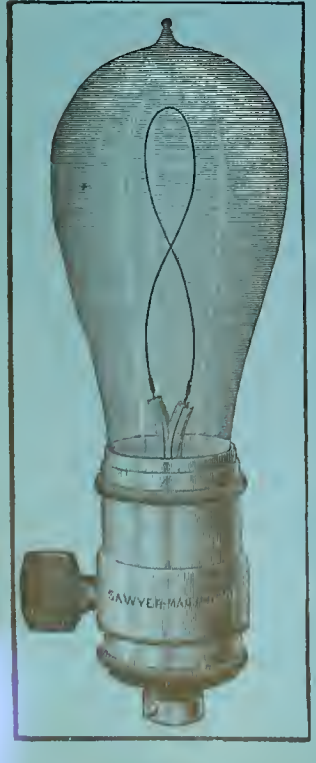


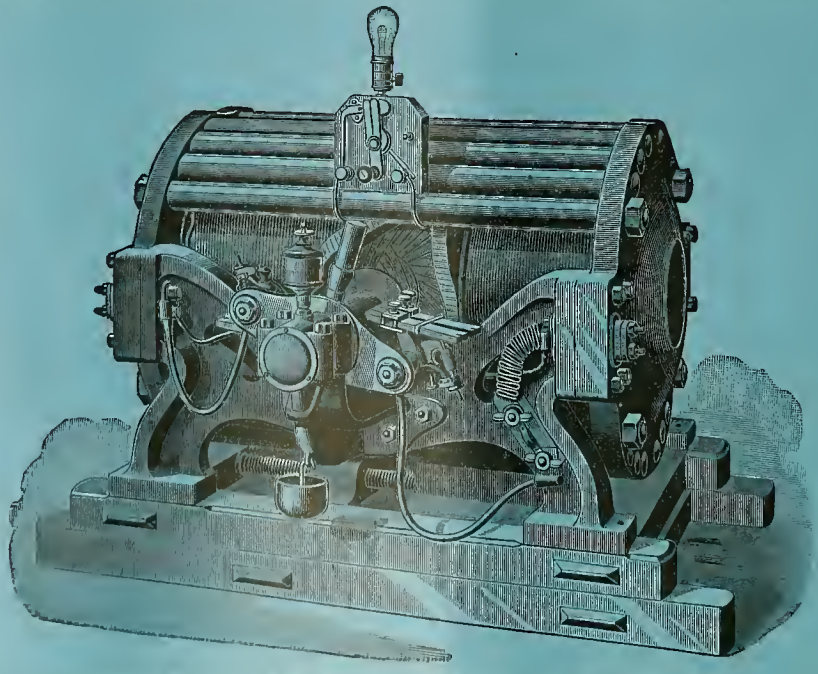
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer





SELF GOVERNING ELECTRIC MOTORS

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $550,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, NVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,

16 & 18 BROAD STREET, NEW YORK.

THE

INDIA-RUBBER AND GUTTA-PERCHA

INSULATING COMPANY,

MANUFACTURERS OF ALL KINDS OF

INSULATED WIRES AND CABLES

FOR ELECTRIC TRANSMISSION OF POWER.

Guaranteed to Give Satisfactory Services Underground and Overhead. Specially Adapted for Mines, Chemical Works, Etc.

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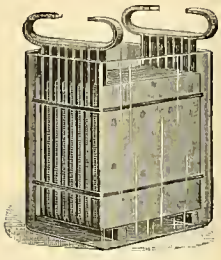

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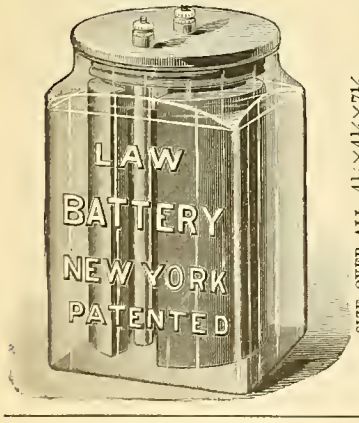

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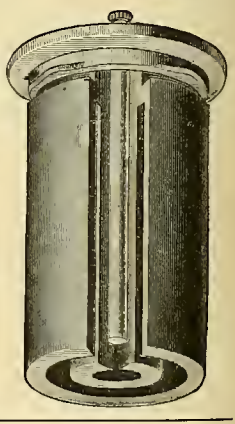

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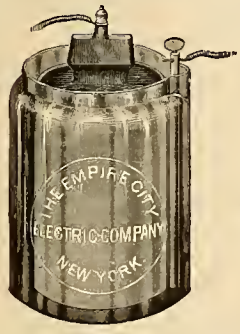

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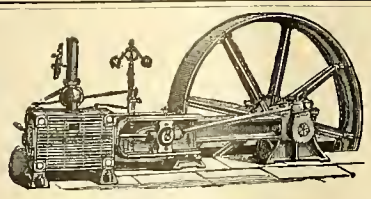

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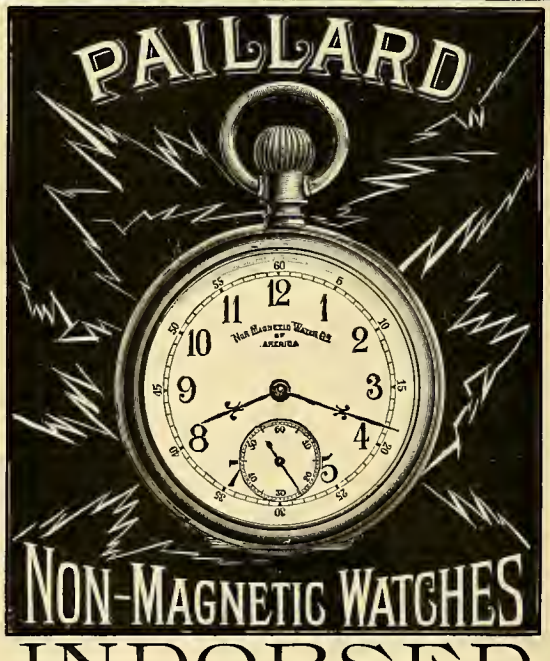

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EVERY SATURDAY.

Vol. III. CHICAGO, NOVEMBER 24, 1888. No. 21.

Monument to Ampere.

At Lyons, France, Oct. 9, 1888, the statue illustrated by the engraving on this page, reproduced from *La Nature*, was unveiled with appropriate ceremonies.

André Marie Ampere, whose services to science have received an imperishable commemoration in this monument, and who was honored by the Parisian Congress of Electricians by the adoption of his name as an expression of the size of a current of electricity, was born at Lyons on the 20th of January, 1775, and died at Marseilles, June 10, 1836. In early boyhood he developed a great taste for scientific pursuits. In 1805 he entered the Polytechnic school as assistant professor, and in 1809 was promoted to the position of professor, and in 1814 he entered the Academy of Science.

Chicago Electric Light Plant.

Within a few days the dynamos to be used for lighting the streets of Chicago will be placed in position in the new station on Jefferson street, near Van Buren street. The machines are of the Western Electric company's make. Five dynamos with a capacity of 150 lights will be at first installed. There is room for 16 dynamos, and the plant will be increased from time to time as appropriations are made by the city council. The engine, which is of 450 horse power, is already in position.

The New Sprague Road at Akron, O.

There are now five cars in operation upon this railway, and the sixth will be running shortly. Ever since its installation the operation of the cars has been very successful, and has given very great satisfaction to the managers of the company, and to the passengers.

A very interesting incident occurred recently, which illustrates the power of the motors used, and the ability to use them for braking the car when necessary. While descending a steep grade with a heavy load of passengers one of the hand brakes of the car broke, and under any other system of propulsion it would have been in imminent danger of accident. Instead of this, however, the driver in charge of the car reversed the motors by a simple movement of the switch, and, although the car was going at full speed down the incline, it was stopped and propelled up the hill within a distance of three feet. This incident shows that for braking the cars by reversing the motors an electric car is under greater control than a car propelled by any other motive power.

Electric Lights in Baker's Theater.

Baker's theater, one of the handsomest places of amusement in Chicago, was opened to the public last Monday evening. The building is located on Wabash avenue, just south of Eighteenth street. It is an ornamental structure, and adds greatly to the appearance of the avenue. The auditorium is the highest of any theater in the city, a dome of thirty-five feet rising clear of the proscenium arch. The boxes are fifteen in number, six on each side of the stage, and three in the center of the balcony. In the construction of the auditorium attention was paid first to the laws of sight and hearing, and next to the rules of beauty. The decorations are unique in character. The prevailing colors are blue and gold. The hangings are plush, and the carpets are of harmonious tints.

Perhaps the electric lights do not come under the head of decorations, but certainly the incandescent lamps, with their handsome fittings, add greatly to the beauty of the house. To appreciate fully this fact a person must see the theater lighted first by gas and then by electricity. The plant was installed by the United States Electric Lighting company, C. C. Warren, manager of the Chicago office. The installation was made under the supervision of E. S. Hewson. Hundreds of incandescent lamps are distributed throughout the house, where they will be ornamental as well as serve a useful purpose. In the dome are two circles of 50 lights. On the face of the sounding board are 53 lamps. The proscenium arch is made brilliant by the grouping of lights. The side walls are studded with the globes. Each box is lighted with two lamps. The effect of these combinations of the lamps is brilliant in the extreme. The lamps on the balcony rail are inclosed in opalescent globes, an arrangement which produces a charming effect. The lamps on the stage are 268 in number. They will eventually be increased to 288. The borders and footlights contain 40 lamps each. The other lamps are distributed in bunch lights, ground rows, etc. A globe in the center of the stage, just in front of the seat of the leader of the orchestra, is used for a flash light. It is used to signal the orchestra, instead of the usual speaking tube. It is manipulated by a push button, which is located at the switchboard. The stage switch-board is one of the most complete, if not the most complete, of any theater in the city. The arrangement of the rheostats is such that by one movement of the bar the lamps in the house can be instantly lighted or extinguished. The stage lights are under similar control. The rheostats are in a fireproof room under the stage. They are of a new pattern. Instead of being mounted on wooden frames, they are constructed exclusively of iron and porcelain. The dynamo room is in the basement of the theater, in the front of the building. This department has not yet been fitted up as it will be when the basement is finished. The room is rather small—too small, in fact, for such an important feature of the theater. There are two United States generators in position, each of 600 lights' capacity. Power is furnished by two 80 horse power Ide engines. The entire number of lamps will be used in lighting the theater and in illuminating the hotel, which is located in the same building.

At the invitation of C. C. Warren, manager of the Chicago office of the United States company, a number of gentlemen interested in electric lighting attended the opening performance. They were greatly interested in the many novel features of the installation. A spectacular play was presented, and much of the brilliancy of the stage effect was due to the excellence of the electric service.

MONUMENT TO AMPERE.

The Future Motor.

Mr. Edison is quoted by an interviewer as saying. "If some means can be discovered by which electricity can be produced from coal without its energy being spent in heat, and the means of doing this can be accomplished at a reasonable expenditure, then the application of electric power as a motor to railroad trains and trans-Atlantic steamers will be a valuable, useful, economic thing. But it has not been discovered yet. Electricity as a motive power is a gain of 85 per cent., and when the means of educing or producing electricity from coal without intervening combustion, and consequent waste of energy is brought about, 300 tons of coal will do the work of 1,500 now when it is burnt, and steam employed as a motive power. But this can't be done with large trains now economically. I am giving a good deal of attention to this subject. I have accomplished this result under laboratory conditions, but these will not do to make the process available from a commercial point of view. Still there is clearly an immense field for advancement in electricity as a motor. The steam engine can't be much more perfected. The term of improvement in that has been about reached. There is only one force, and that is energy. It comes in many ways; is a molecular movement or a mass movement, and heat, light, sound and electricity are only modes of this motion. Hence you can see that if the latent force in coal can be educed as electricity without letting so much of it go to waste in combustion, it will take the great step forward in this matter."

An electric railway at Alliance, O., which is being equipped by the Thomson-Houston company, Chicago, will probably be in operation by the middle of December. The company has taken the contract for the construction of the road bed and the cars as well as the installation of the steam and electric plant.

The Silvey Alternating Current Street Car System.

W. L. Silvey, of the Silvey Electric company of Lima, O., has developed a system of electric street railway traction by alternating current motors. The advantages of such a system are apparent. Currents of 1,500 to 2,000 volts may be employed in the line with safety to the motor, and in fact to the entire system. The distance that can be covered is from three to four times as great as can be covered by a direct current system; and the cost of construction and maintenance is in favor of the alternating system. Mr. Silvey has devised several modifications of his apparatus, among which are the following: First, to use the alternating current to charge a series of converters located on poles along the track, all the primaries being connected in multiple arc to the high tension line, and all the secondaries joined in multiple to a secondary line situated directly over the track, as shown in Figs. 1 and 2. In this case trolleys attached to the car convey the current of 40 or 50 volts to the motor on the car. This low tension in the motor makes the matter of insulation very easy, and for this reason alone the burning out of a motor can be entirely prevented. In fact, such an accident would be directly attributable to dire carelessness.

Still another way of coupling the line circuits, and the one Mr. Silvey considers preferable in all cases, is shown in Figs. 3 and 4. In Fig. 3 both the outgoing and the return wire are shown overhead, two trolleys being attached to the car. In order to simplify the system still more, the single overhead wire and the return through the rails are employed. In Fig. 4 the overhead line is charged by the high tension current of an alternating dynamo, one wire being attached to the rail for a return or ground wire, thus saving a large per cent. of the line work. The current from the line is conveyed to the car by a trolley, while a converter is located on the car either underneath the floor, or under the seats. The secondary wire of the converter is attached to the motor, regulation being secured by a choking coil in the secondary motor circuit.

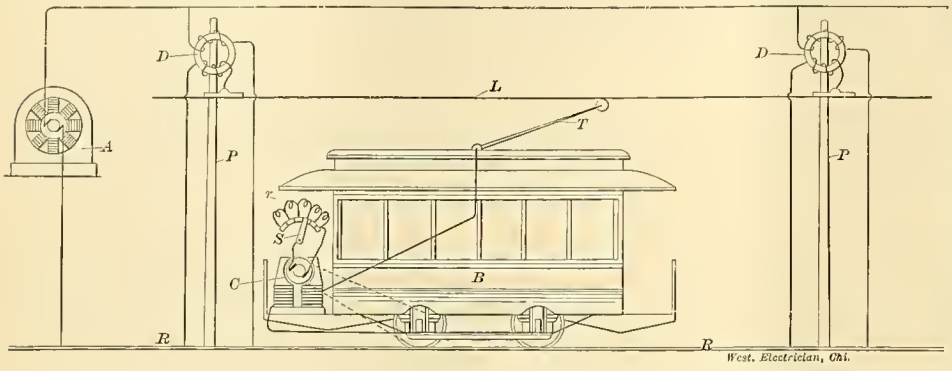

FIG. 1.

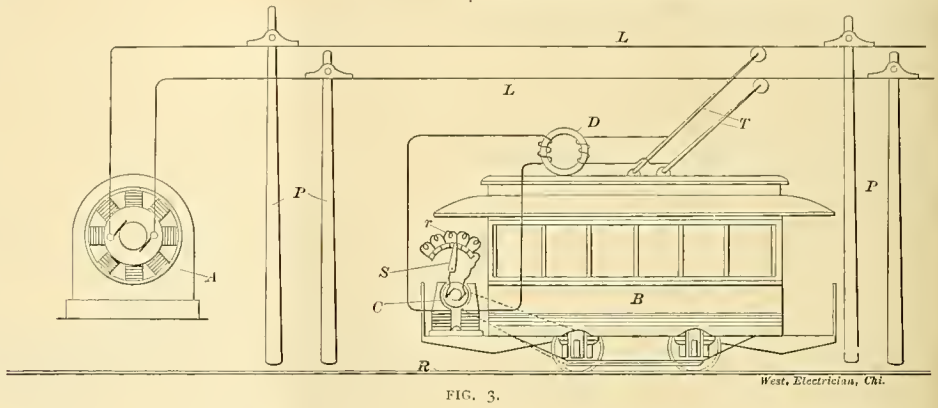

FIG. 3.

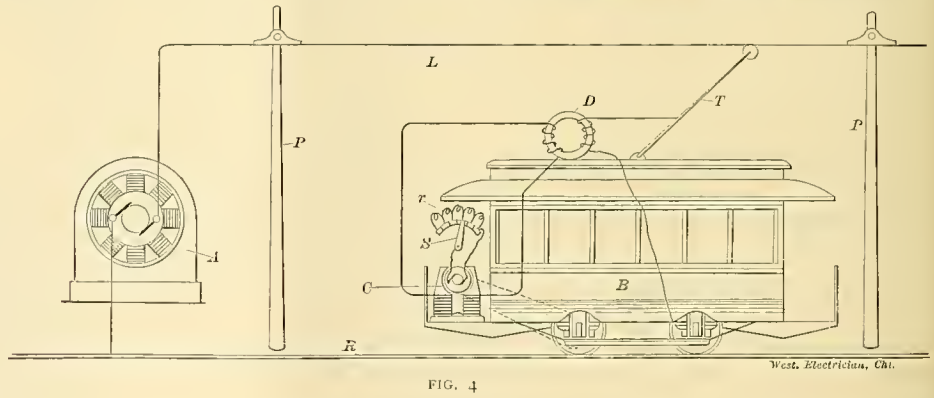

FIG. 4

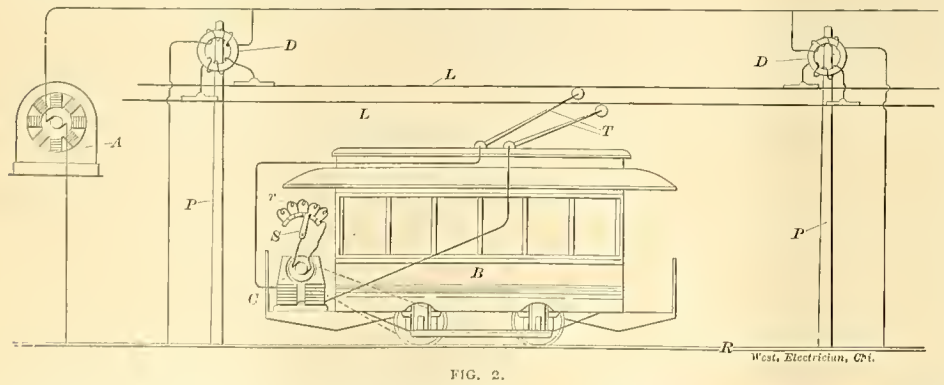

FIG. 2.

This does away with switches entirely—a constant source of annoyance. The armature circuit is entirely independent of the field magnets, and the current in the armature being of so low a tension as three or four volts, there is little or no danger to the machine.

The Thomson-Houston company of Chicago has sold a 100 light arc plant to the Columbus Electric Light & Power company of Columbus, O.

The Geyer-Bristol Meter for Direct and Alternating Currents[1].

By Prof. William E. Geyer.

In this meter we make use of the heating effect of the current. Electric measuring instruments depending on this heat effect are not new. In the Cardew voltmeter we have an application which has found much favor. Here the current of greater or less strength traverses a long, thin wire, heats it more or less, and the direct expansion is a measure of the current, and indirectly of electromotive force.

In an ammeter it is necessary to keep down its resistance, and I therefore doubt whether direct expansion can be usefully applied for this purpose; for the actual elongation of a bar of metal even when raised through a considerable range of temperature, is very small. In the familiar compound bar we have a case where a very small actual elongation produces a relatively very great lateral displacement.

I think I shall best be able to explain to you our meter, by recalling to your minds this old device. In the simplest compound bar two strips of metal which have different coefficients of expansion are securely soldered flatwise along their entire length. Brass and steel are metals frequently taken. On heating, the brass expands more than the steel, and in consequence the bar bends, becoming convex on the side of the brass. When such a bar is heated by the passage of the electric current, it will deflect, and this deflection may be made a measure of the current. The disadvantage of such an instrument would be that atmospheric changes of temperature would also cause deflection, so that troublesome corrections would have to be introduced.

In our meter we also use a sort of compound bar, but eliminate at once the effect of surrounding temperature by taking metals whose coefficients of expansion are the same or sensibly equal, in fact, we take the same metal. Our first form of construction was as follows: A wire of German silver is laid upon a strip of German silver, of considerably greater cross-section and radiating surface. The wire and strip are soldered together at one end, separated for the remainder of the length by a film of mica, then tied together at frequent intervals with silk or other insulating material, and suitably supported or clamped at the unsoldered end. If now a current, either continuous or alternating, is allowed to enter the strip at one end, it runs along its length, there enters the wire and leaves the instrument from the other end of the wire.

For a given current in the wire on account of its greater resistance and also on account of its smaller radiating surface, the wire becomes hotter than the strip. In consequence of the difference of expansion, the bar bends, becoming convex on the side of the smaller conductor. This combination we call a differential bar.

We would also state that, inasmuch as the results obtained by the use of this instrument are due to the excess of the heating effect of an electric current upon one portion of the bar or its equivalent over the other, it is in a measure immaterial to the principle of the invention whether the current which produces the differences in temperature be caused to heat the two parts directly or indirectly. For example, the more expansible part, in lieu of being included directly in the circuit, may be arranged in close proximity to, but insulated from a wire or conductor which is heated by the current The other part or element may be in the circuit or not; but in either case formed or arranged to be less sensibly heated than the other.

It will readily be seen, however, that to heat one or both of the parts of the device in this manner would be clearly equivalent to connecting them both in series in an electric circuit. Unlike the case where magnetic action is employed, the force here available is very considerable, so that to make the instrument self-recording it is only necessary to attach an inking device to the free end and move in front of it a properly ruled chart. In this respect we have no difficulty whatever. My associate, Prof. Bristol, who has done the larger part of the work has since our first experiments very much simplified the method of constructing the differential bar, and the one used in the instrument exhibited was made by placing a flat strip of German silver between a pair of dies which make alternate depressions and elevations along the length of the bar; the wire, insulated with asbestos, was then slipped in the tube-like space thus formed, and the whole pressed between plates provided with grooves of the proper depth so as to leave the wire to one side of the center line, and at the same time to insure its being held firmly by the little bridges along the length of the bar. Since the bars can be constructed essentially by these two machine operations it is evident that they may be readily reproduced, and at very small cost.

We have determined experimentally the best relation between the cross-section of the strip and wire to give maximum deflection. We believe the instrument could readily be made integrating, but doubt the desirability of doing so. Our reason for this could probably not be better expressed

[1] Read before the American Institute of Electrical Engineers, New York, Nov. 13, 1888.

than in the words of an eminent engineer, Charles E. Emery, in his paper on "Heating cities by steam," before the Franklin institute, which we quote as follows:

"It was at first considered unfortunate that a reliable meter could not be obtained, which, like a water meter, would show by differences of reading the quantity of steam used for the interval between observations directly without calculation, and without expense of maintaining a time register at each location, and of integrating the charts afterward. This system, however, proved a blessing in disguise.

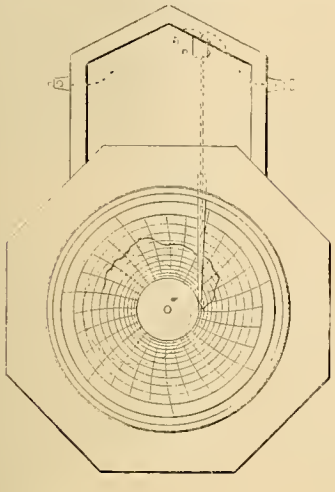

Fig. 1

The greatest difficulty in settling with consumers lies in the fact that employes waste the steam. This is particularly the case during the heating season, when steam for various uses is left on continuously during nights and Sundays. thus increasing the time of consumption from, say, sixty hours a week to 168 hours. In many cases, too, the rate of consumption keeps uniform during the night as well as during the day, so that it is an easy matter to more than double the bills. The consumers at first naturally lay the

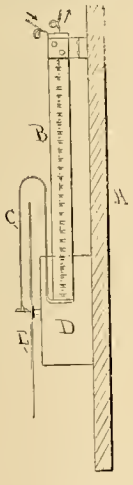

Fig 2.

blame to the steam of the steam company, but the meter charts have been the means of enabling the company to satisfy consumers when, and to what extent, the increased bills were due to mismanagement on their premises."

Substitute electricity for steam, the reasoning will apply perfectly to our case.

Fig. 1 is a general view of the differential bar, mounted in a case with inker and recording dial.

Fig. 2 is a side view of the important parts, the case being removed. A is the supporting framework; B the differential bar; C inking pointer attached to the bar; D

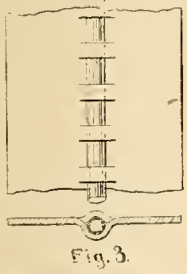

Fig. 3.

clock work moving dial; E revolving dial for receiving record.

Fig. 3 shows a small portion of the bar and a cross-section on an enlarged scale.

Leonard & Izard of Chicago are now agents for Edison isolated plants in Minneapolis, Minn.

Bell Hangers' Hand-Book.[1]

By F. B. Badt.

PART VII.

GAS LIGHTING APPARATUS—Continued.

Chapter LII.

Apparatus for Public Buildings—Continued.

Instead of the induction apparatus a frictional electric machine is sometimes used. These instruments, however,

FIG. 70.

are not as reliable as good induction apparatuses. Fig. 70 represents a frictional gas lighting machine with a switch connecting to four groups of burners.

Chapter LIII.

Apparatus for Residences

The Ratchet Pendant.—This burner obtains the name "ratchet" from the fact that it has a ratchet wheel govern-

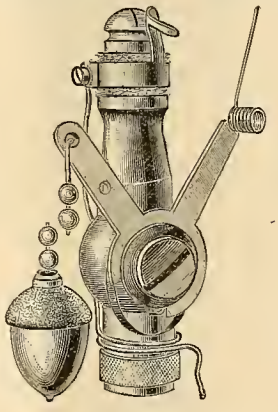

FIG 71

ing a stop-cock, so arranged with a pawl and spring that one pull of the chain turns the wheel one notch forward, bringing one of the gas-ways of the gas-cock in direct line with the burner gas-way, thus turning on the gas, and at the same time, through the electrical connection, lighting it.

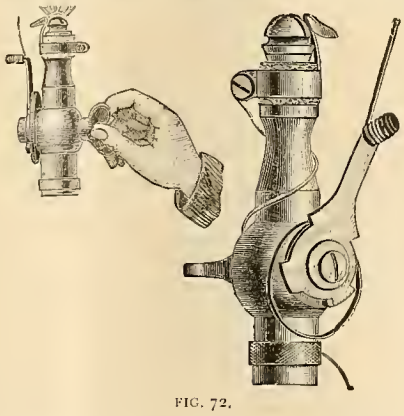

FIG. 72.

The next pull of the chain turns the ratchet wheel another notch, and the gas is turned off. See Fig. 71.

The Plain Pendant.—The plain pendant, Fig. 72, differs from the ratchet in that it does not operate a stop-cock, but simply lights the gas after it is turned on by the ordinary key. This burner is especially useful in stores, or in the kitchen, where the ratchet-burner is not necessary, thus materially reducing the cost and the possibility of the gas being left escaping where the burners are subject to the use of ignorant or careless persons

Argand burners are fitted both as ratchet and plain pendants, and they differ from the common burners only in having argand instead of the ordinary burners above the stop-cock. Gasoline burners can be fitted to light by electricity, also.

The Automatic System is that by which the gas is lighted and extinguished from some distant point by buttons placed

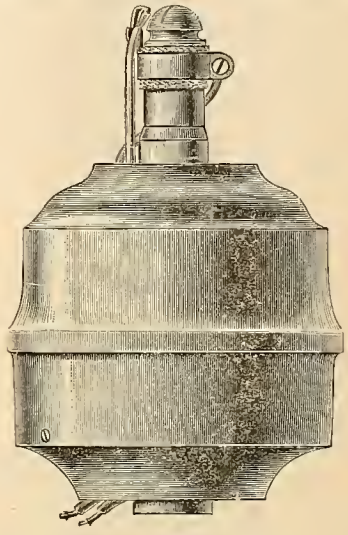

FIG. 73.

in the wall for that purpose, and consists of automatic burners, Fig. 73, and push buttons, Fig. 74, or keys, for lighting them. In the automatic system, electricity not only lights the gas, but turns it on and off. This is accomplished by electro-magnets, governing an armature which,

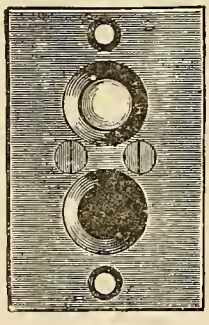

FIG. 74.

by a lever, operates the gas-cock; so that when the armature moves in one direction, the lever moves the stop-cock and turns on the gas; and when the armature moves in the other direction, it turns off the gas. This system is not adapted for universal use in houses, for in most places, as on chandeliers, the pendants are much more convenient, and cost very much less; but in a few places the automatic

FIG. 75.

is almost indispensable. One in the front hall, Fig. 75, to be lighted by buttons placed at the front door or by the chamber door, or one in the cellar, with push buttons or keys at the head of the cellar stairs, or at some convenient point in the cellar, or one in the family chamber, to be lighted from the bedside and chamber door, are all luxuries which, after accustomed use, become necessities to household comfort.

[1] Bell Hangers' Hand-Book, by F. B. Badt, author of Dynamo Tenders' Hand-Book; in course of preparation; about 100 pages, 80 illustrations; flexible cloth binding; type page 6 inches by 3 inches; price $1. All rights reserved.

CHAPTER LIV.

A Novel Automatic Burner.

The interior of a novel automatic burner is shown in Fig. 76. D, is a shell containing the helices, four in number, of which only two, M. P, are shown; the four, by means of the iron disk, K, constituting two horseshoe magnets. The armature, J, is suspended below the cores by means of the valve stem, H, which is attached to the conical valve, G. When a current is passed through two of the helices, the armature is raised and rotated to the left into the position indicated by the dotted lines, bringing the recess, *d*, over the hook, *e*, and when the current is broken the armature falls upon this hook, locking it and holding the valve above its seat, permitting egress of the gas. The spark-producing mechanism referred to above consists of an arm, U V, bent at right angles, and passing through the wall of the tip socket at V, and terminating over the valve at W, the point, V, constituting a valve and valve seat, the spring, *i p*, at all times pressing these two parts together and keeping them gas-tight, and at the same time pressing the two platinum sparking points, U T, into contact. Therefore, when the valve is first lifted it reaches the termination, W, of the

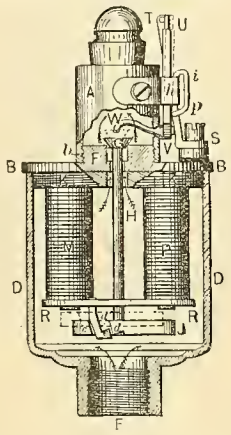

FIG. 76.

vibrating lever, W V U, and pressing it upward breaks the circuit at the points, T U, producing a spark; as a consequence, a vibrating action with a continuance of sparking results as long as the operating key is kept closed with the finger, as in other burners for a similar purpose. To extinguish the lighted gas, it is only necessary to close the circuit through the other two helices to the ground, when the armature is lifted and rotated free of the locking hook, and dropped when the circuit is opened at the key.

It will be seen that the valve cannot be possibly opened by accident; that on account of the extremely short movement of the armature, but small current is required to operate it, and that with the same amount usually employed with automatics, this burner will have far greater power to overcome any tendency to stick through deposit from the gas. No springs, or parts requiring any adjustment, are found within the burner.

Advantages claimed for this automatic burner are: Instead of the valve-operating mechanism being outside of the gas pipe, it is contained within it, thereby obviating friction due to packing of valve stem or springs to hold valve in its barrel; instead of using the traditional rotary conical gas cock, requiring to be lubricated and held firmly to its seat by pressure of a screw or spring, an extremely small clack valve is employed, which, in opening, is simply lifted from its seat one-sixteenth of an inch; the armature, but one being employed, instead of making an extended excursion, has for its maximum movement the play of the valve, to which it is rigidly connected by a valve stem, and the armature motion is a double one, it being first attracted

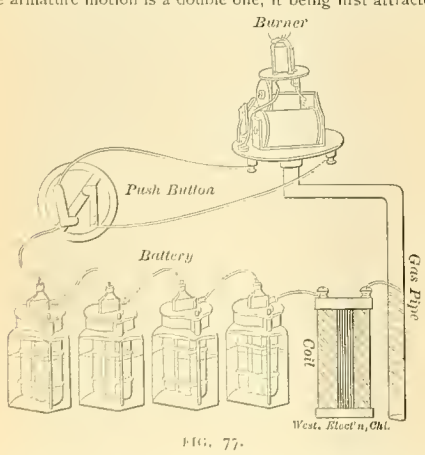

FIG. 77.

upward to open the valve, and then rotated horizontally so as to engage a recess in it with a stationary hook, thus locking it open. To extinguish the flame it is only necessary to energize a second pair of helices, when the armature is raised, rotated free of the hook, and then dropped into its normal position, closing the valve.

CHAPTER LV.

Connections of the Automatic System.

The gas is lighted by the electric spark, which is caused by breaking the circuit at the point where the gas issues from the tip. An induction coil is connected in the circuit to increase the size of the spark.

Fig. 77 shows the method of connecting the battery, coil and automatic burner. Use number 18 B. & S. gauge heaviest rubber-covered wire for leads, and on the gas fixtures number 22 B. & S. gauge triple-covered wire, of a color to correspond with the color of the fixtures.

Having laid out the shortest and most accessible route for running the wires, run a wire from the zinc pole of the battery to one of the binding posts on the induction coil; from the other binding post on the coil run a wire to the nearest gas pipe in a cellar, closet, or under the floor. File the pipe clean, being careful to remove all corrosion; then uncover about three feet of the wire, wrap it firmly around the prepared place and solder it fast; this gives good ground connection. Run another wire from the carbon pole of the battery to the center strip of the push button, which should be placed so as to bring the buttons in a vertical line, the white one being uppermost. Run a wire from the right-hand spring to the lighting wire of the burner. Run another wire from the left-hand spring to the turning-off wire of the burner, which will complete the circuit, and the gas will be alternately lighted or extinguished upon pressing the light and dark buttons.

ELECTRIC HEAT REGULATION.

CHAPTER LVI.

Electric Heat Regulators.

We have shown in Chapter XLVII how metallic thermostats can be used as fire alarms. Their application to heat regulation follows at once as a natural development. In such systems they serve as the actuating device to set other apparatus in motion, which in turn opens or closes a damper of a furnace, or a valve in a steam pipe, or opens or closes a ventilator. Various forms of power are utilized in the apparatuses that do the actual work. Electricity may be employed through the medium of an electric motor, though considerable battery power is required; compressed air is sometimes used, and even water under a head can be employed. Clockwork is also utilized. The thermostat, however, is the prime agency, since upon its action depends that of the power that actually performs the work. The adjustable thermostat consists of two strips of dissimilar metals, or other substances, which are riveted together, and which expand unequally under varying temperatures, as shown in Chapter XLVII.

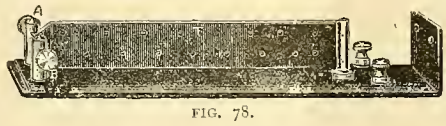

FIG. 78.

Fig. 78 illustrates an adjustable thermostat. *T* is the strip composed of two different metals; *A* and *B* are adjusting screws. It does not matter, of course, in what position the thermostat is placed, whether perpendicularly or horizontally. The figure shows the thermostat in a horizontal position, but in practice the instrument is more frequently hung in a perpendicular position like the ordinary thermometer.

The thermostat is placed in a room where a certain aver-

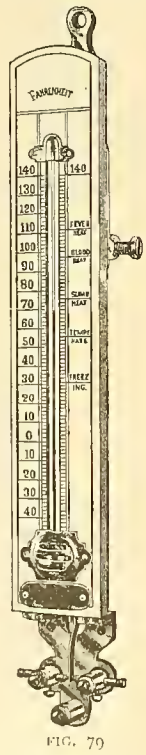

FIG. 79.

age temperature is to be maintained. At this temperature the strip must be so adjusted that it will touch neither adjusting screw. As soon as the temperature falls the strip will twist in one direction, and make contact with adjusting screw, *A*; if the temperature rises above the normal, a contact at *B* will be made. These contacts are used to close a circuit and operate either two different electro-magnets or a little electric motor, or other devices. The armature of these magnets or motor is directly or indirectly connected with the damping device. As soon as the temperature is again at its normal the thermostat opens the electric circuit, and the moving mechanism of the damping device is stopped or reversed. A thermometer is frequently attached to the thermostat.

Fig. 79 shows a combined thermometer and thermostat, the latter part of the instrument being indicated by the binding screws at the bottom for the circuits.

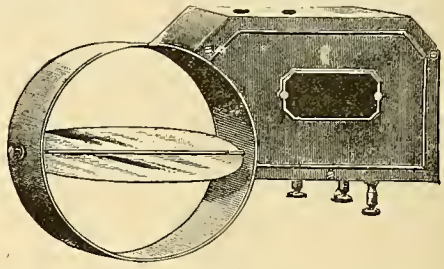

FIG. 80.

Fig. 80 shows a damper actuated by an electric motor within the box.

Fig. 81 is a diagram of connections to such a device, *A*, *B* and *C* being the connections to the thermostat, *T*. Contact at *A* will send the current in a certain direction through

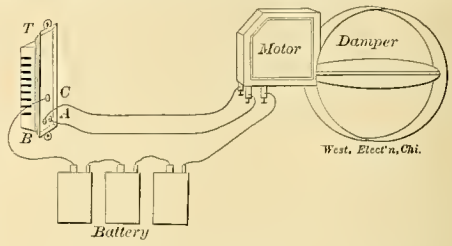

FIG. 81.

the motor, and revolve the armature so it will open the damper; contact at *A* will send the current in an opposite direction, revolve the armature, and hence the damper the other way.

(*To be Continued.*)

National Electric Light Association.

At a meeting of the executive committee of the National Electric Light association in Pittsburgh, Monday, November 19th, there were present: S. A. Duncan, president of the association; B E Sunny, chairman of the executive committee; J. F. Morrison, E F. Peck, T. Carpenter Smith, W. A. Kreidler, W. H. Harding and A. V. Garratt

The resolution adopted at the New York convention relating to a permanent office and secretary was declared unconstitutional, and W. H. Harding was found to be still the legal secretary and treasurer of the association On Mr. Harding's resignation, however, Mr. Garratt was selected to fill the vacancy until the February meeting of the association in Chicago. Mr. Garratt's salary was fixed at $166.66 per month, and he was voted $100 per month, in addition, for office rent and expenses.

There was some objection to the idea of a permanent office and a permanent secretary drawing a full salary, but it was finally decided to put the matter on trial from the present until the February meeting, and see what would result from the experiment in the way of larger membership and increased usefulness of the association. After a three months' trial the association can decide in Chicago whether it desires to continue the experiment further.

It was decided to hold the Chicago meeting February 19th, 20th and 21st. The committee will labor hard to make the Chicago convention the most successful one ever held, and especially so in the matter of exhibits. The executive committee will rent a large hall outside of the hotel, which will be devoted entirely to exhibits, and the secretary of the association has been directed to notify all manufacturers and probable exhibitors of the fact that the association will be ready to furnish them space for as large exhibits as they may desire to make at the Chicago meeting. It is already evident that the Chicago convention will be a memorable one as to exhibits.

It is known to those who study the literature of secondary batteries that for some two years or more W. J. S. Barber Starkey has been using sulphate of soda as the electrolyte in his storage cells, and he has always found it prevented injurious sulphating of the plates, says the London *Electrical Review*. Recently he left home for three months, and during that period the cells were never charged. He examined them on Wednesday morning, and could detect no difference in their appearance from the time they were last charged; they seemed to be in perfect order, the peroxide plates a dark brown, and the others like clean metallic lead. There was not a trace of white sulphate on any of the plates, and they light up the lamps as brightly as if they had been just charged, although they have been left to themselves since August 6th. The cells have been in use for about three years, and although at first Mr. Barber Starkey was troubled by the sulphating and bending of the plates, he has never experienced any trouble of any description since he added carbonate of soda to each of the cells, two years ago. He can now leave the cells with perfect confidence, if required, for several months without any charge. His charging current has always been limited to 12 amperes, but is generally only 10, and he always stops charging as soon as any gas is given off, although he is quite aware that this course is not usually adopted

British Association.

The papers on electric lighting subjects were discussed together by section G of the British association. The paper were Professor Forbes, 'Electric Lighting in America; Henry Edmunds, 'A System of Electrical Distribution," and W. Lowrie, "The Measurement of Electricity in a House to House Supply." Abstracts of these papers have been published in the WESTERN ELECTRICIAN. A synopsis of the discussion follows:

Sir William Thomson said he had heard with great interest of the advance in electric lighting in America. What took place in that country was only partially known in England, but the more they heard of it the more they admired and held it up as a standard which they ought to reach and surpass in their own country. They certainly had been slow in attaining such results as had been achieved. The great question of to-day in electric lighting was, Which of the two kinds is to be—the alternating current system, or the constant current system. There was one way of carrying out the direct current system, and that was, by the use of accumulators. He did not think it was possible to decide which was the better system. Possibly one might prevail for a time and the other ultimately. There were important economic questions to be decided. There was the great cost of the accumulators, for instance, which must be considered If it were not for the cost of the accumulators he thought they might all say that the direct system might be expected to prevail over the alternating transformers One great point with the latter was the difficulty of applying machines in parallel to work together. Some who had gone into the question had come to the conclusion that very large dynamos, giving the whole amount of work should be used, and for less work one smaller dynamo. Had that been worked out in practice so as to give satisfactory results? How about the dynamos keeping absolute time if they were joined by belts and not coupled rigidly together on the one axis? There was another subject to be considered: Given two or three or more alternate current dynamos rigidly connected with one belt, the question was, would an electric current stay quiet and distribute itself equally between the different dynamos? That was a question that could be answered theoretically, but they wanted to hear something of practical results. Prof. Forbes had spoken of different dynamos not coupled together rigidly, but each driven by a belt. Did the tendency to keep together in those cases, when once they got within a certain narrow limit of being exactly in time, suffice to keep them together irrespective of slight slips of the belt? He could not quite agree with what Prof. Forbes said about the voltage of lamps. To the best of his knowledge a 100-volt lamp was much more desirable than a 50-volt lamp. If it were true, that 50-volt lamps had greater durability, that would be a strong reason for preferring them, but it would not be a determining reason. In all other respects 100-volt lamps were much more convenient. The copper used in wiring a house requiring two or three hundred lamps was very considerable but it would be just half with 100 volts what it would be with 50 volts. The fact that a smaller current would be required was another strong reason in favor of 100 volts In houses two things had to be considered, safety and convenience on the one hand, and economy on the other. At present they were perfectly happy with 200 volts in their houses; and if they could get 200 volt lamps from the lamp maker nearly equal in durability with the 100 volt lamps, he should strongly prefer them. He would not go below 100 volts. Turning to another question of great practical importance, Sir William said he thought 8,000 alternations would introduce more sources of want of actual economy than it would avoid, but with 5,000 alternations per minute there was only about 3 mm. of the conductors that was useful up to 65 per cent. of the full conductivity of copper. But if they got 3 mm. in from the circuit, if the average current was only 65 per cent., the result was that if they were satisfied with less than 65 per cent. conductivity, they might make it thicker. But it was a sure rule that if the alternations were to be at the rate of 5,000 per minute, the conductors should be either thin plates which might be 6 mm. thick or tubes 3 mm. thick. That was a very large question, and pointed to a greater ease of getting copper to do its work with 5,000 than with 8,000 alternations.

R. P. Sellon said he thought there was little reason to doubt that low e. m f. lamps were longer lived than high e. m. f lamps, looking at the question purely from the point of view of the life of the lamp. One reason for this lay in the fact that the smallest impurity which existed in the carbon in the initial stage of its manufacture, would amount to a much smaller proportion of the whole cross sectional area in the case of a low e. m. f. (and consequently comparatively thick) carbon, than in the case of a high e m. f (and consequently comparatively thin) carbon. Thus the temperature of the low e. m. f. carbon would be the more uniform along its length, of the two. Then the extreme flexibility of very high e m. f. carbons was an objectionable feature It was difficult to give any definite figures as to the relative life-values of high and low e. m. f. lamps, because incandescent lamps in practical work were usually run in a most haphazard sort of way as regards temperature, thus quite stultifying the value of the results obtained in respect of duration. With regard to central station lighting-work in America, he could corroborate everything that Prof. Forbes had said, as he traveled through most of the eastern states last autumn. One was astonished at the energy and activity of the Americans throughout the states, small and large, and at the amount of work being done. The Americans had one advantage which electricians in England could not obtain by any means in their power; they were favorably handicapped in the first place by the fact. that the gas interests there were very small, and further by the fact that generally speaking, the gas was not so good as in England. Gas was not really an established going concern i America in the sense it was in England.

Sydney F. Walker said with regard to the 100-volt and 50-volt lamps, his experience was the same as that of Sir William Thomson. A 100-volt was quite as good as a 50-volt lamp, and so far as he could understand, it was a question of manufacture; that was to say, the greater perfection of the low-volt lamps at first was due to the fact that a greater number were made He was quite sure that any saving that might be made by using 50-volt lamps would be more than counterbalanced by the extra cost of wiring. He would go even further and say use 200-volt lamps, and save still further in that way. With regard to the system which Prof. Forbes had described, he did not think there could be two opinions. They must all admire the energy and skill with which the whole thing had been worked out from end to end. It showed what a highly educated man, with plenty of capital at his back, could do. He was glad to know that Mr. Westinghouse only used 1,000 volts instead of 2,000 volts in his mains. This gave an increased margin for safety. He thought he was borne out by some recent experiences in London in saying that those high voltages would possibly lead to trouble; they had, he believed, led to trouble already.

(To be continued.)

The Abdank Magnetic Call and Integraph[1].

BY B. ABDANK-ABAKANOWICZ.

Permit me to speak first of a small improvement in magnetic calls. The instrument that you see here, Fig. 1, was constructed as long ago as 1882, when calls for telephones were wanted everywhere The principle of this call is extremely simple. For producing electromotive force we are obliged to move a coil through a magnetic field. I fix my coil at the end of a straight spring, the other end of which is solidly held by the support On the same support are fixed two magnets that create the

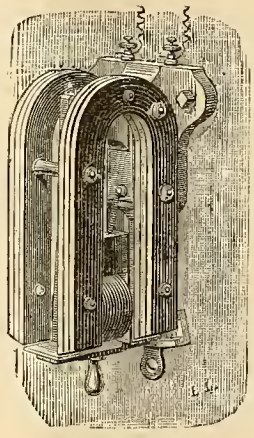

FIG. 1.

magnetic field If I move the bobbin from its neutral position, thus bending the spring, I am storing up the muscular energy of my hand in the spring. If I remove my hand this energy is restored in a series of oscillations of the bobbin through the lines of force. In this way an oscillatory current is produced in the closed conductor, and the mechanical energy reappears on the other side in the form of the movements of the bell striker I have made similar calls of different sizes, beginning with half the size of this one, about four inches, up to others where the diameter of the bell was three or four feet. As the electromotive force developed is very high the working distance is very great. This small one can ring a bell to a distance of over 100 miles over an ordinary telegraph wire. We have tried successfully larger calls on lines over 600 miles

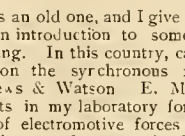

FIG. 2.

The apparatus is an old one, and I give the short description of it only as an introduction to some theoretical remarks on its working. In this country, calls approaching to mine. based on the synchronous movement, were patented by Andreas & Watson E. Meylan has lately made measurements in my laboratory for the purpose of finding the curve of electromotive forces produced by the passage of the coil across the magnetic field, and this is the subject of my communication to-night.

If we admit that the instrument is symmetrically constructed and that the magnetic fields are equal in strength, then the curve of induced electromotive forces must have a regular shape. We neglect also the retarding influence of eddy currents induced in the iron core. We must have the greatest electromotive force in the middle, where the ratio of variation of the quantity of lines of force is the greatest.

The curve obtained by direct measurement was very different in shape, being as shown in Fig 2.

This curve presents two remarkable features. First, we see a depression in the middle, where theoretically the electromotive force ought to be a maximum. The reason for this is to be found in the defective form of the iron core in the armature. Fig. 3 will clearly explain this. This defect in the construction has a very bad influence on the result, the greatest and most useful electromotive force being lost as shown in the dotted line, Fig. 2, and the same defect was often found by me in different alternating current dynamos.

The second characteristic feature of the curve is in the shifting of its ordinates in the direction of the movement of the armature. Beginning from the starting point the curve is convex, and near to the other end concave in relation to the middle ordinate. When the armature moves backward the same deformation was remarked, but in opposite direction. The electromotive force produced was always somewhat behind the time in which it ought to have been produced We supposed at first that this was due to the retardation in the indication of the electrometer used for the measurement, but we found by different controlling methods that this was not the case, and that this retardation is probably due to the action of eddy currents induced in the armature core. As you see, the maximum points of the curve are not symmetrically placed. This proves that the magnets did not possess the same strength of magnetic field. The method used for the measurement of the ordinates of these curves was very simple. The variation of the magnetic field in the path of the armature

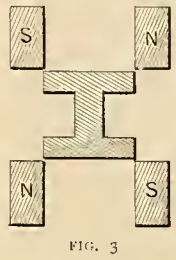

FIG. 3

was also found experimentally, and then control'ed by direct integration of the curve of electromotive force. The ballistic method was used for the measurement. This method allows of the measurement of the variation of the quantity of lines of force independent of the time. The total variation of the magnetic flux was found to be:

$$\Sigma d F = 5.1 \times 10^7 \text{ (C. G. S.)}$$

The mean current was .021 ampere. The mean power was .26 watt

The curve of the variation of the magnetic field can be found directly from the curve of e. m. f. as before alluded to. Every ordinate of the curve of e. m. f. is proportional to the ratio of the variation of the number of lines of force. It is equal to the differential coefficient $\frac{d F}{d x}$

Let us consider the four curves in their relation. Every ordinate, for instance AB, Fig 4, is proportional to the ratio of variation in the corresponding point of the second curve. This ratio is measured by the ratio $\frac{d y}{d x}$ where d x represents time The ordinate AB in a given scale is equal to the numerical value of the differential coefficient. Every ordinate of the curve of e. m. f. represents the differential coefficient of the corresponding part of the magnetic curve The magnetic curve is simply the integral of the e m. f. It is obvious that if the equation of the e. m. f. were given, it would be possible to find the magnetic curve by integrating this equation

This integration can be performed mechanically by an integrating machine. There is one of these machines constructed in Zurich by the celebrated constructor, Coradi. To perform the integration it is sufficient to follow with the tracing point the given curve. The integral curve is then mechanically traced by the instrument. The integration of differential equations is a problem that we meet continuously in the physical sciences. We perform an integration in determining the area of a given figure; also in determining the static moments and the moments of inertia, in calculating the shape of the elastic curve

The planimeter, as you know, gives mechanically the area and the moments. The instrument that you see before you gives much more. It traces a curve that indicates how the integral increases. The curve is the integral curve, the applications of which are extremely numerous. You have seen one of these applications for the determination of the magnetic curve.

I am glad to have had the opportunity to present it to this electrical society, and, as it were, smuggle into your presence a mathematical instrument under the cover of an electrical application. And I do so because the apparatus interests me personally, being myself the inventor of it

I must also crave your pardon for having addressed you in English, of which language I am not at all a complete master, and I am ashamed because that lack of knowledge is entirely contrary to my principles. I am of the opinion that every electrician ought to be able to speak English.

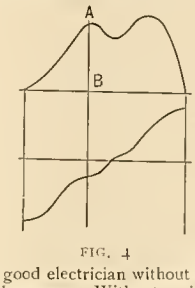

FIG. 4

He cannot be a good electrician without being a complete master of that language. Without an intimate acquaintance with the works of Faraday he is not able to draw conclusions in a simple and logical manner from experiments. He cannot, without being in direct communication with the legion of workers in electricity who speak the English language and who have advanced electricity in this country to a point where it is fifty years ahead of that in Europe, I say, that without knowing it intimately, he cannot keep track of what can be done with that power of nature which we are all attempting to harness.

[1]Read before the American Institute of Electrical Engineers Nov. 13, 1888.

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CONTENTS OF THIS NUMBER.

PAGE

Monument to Ampere, Illustrated .. 265
Chicago Electric Light Plant 265
The New Sprague Road at Akron, O. 265
Electric Lights in Baker's theater 265
The Future Motor 265
The Silvey Alternating Current Street Car System, Illustrated 266
The Geyer-Bristol Meter for Direct and Alternating Currents, by Prof. William E. Geyer, Illustrated 266, 267
Bell Hangers' Hand-Book, by F. B. Badt, Illustrated, Part VII.: Gas Lighting Apparatus, Continued. 267, 268
Electric Heat Regulation 268
National Electric Light Association 268
British Association 269
The Abdank Magnetic Call and Integraph, by B. Abdank Abakanowicz, Illustrated 269
Editorial 270
American Institute of Electrical Engineers 271, 272

DEPARTMENTS.

Correspondence 272, 273, 274
The Electric Light 274
The Electric Motor 274
The Telephone 274
The Telegraph 274, 275
Electrical Patents 275, 276

AN interesting electric light installation at Baker's theater in Chicago is described in this issue. All the popular theaters in Chicago, with perhaps one exception, are now supplied with electric lights. The change from gas has added greatly to the brilliancy of stage effect as well as contributed largely to the comfort of patrons.

THE long distance telephone proved of the greatest value on election night. In many cities east of Buffalo it was largely used, and returns were obtained much more speedily than the figures could have been secured if the telegraph had alone been depended upon. In Buffalo the collection of returns was conducted as a trial of the system. The organizations, to the headquarters of which returns were forwarded, have sent to the telephone company congratulating the officers on the marked success of the service. The record of the night was a triumph for the long distance telephone.

SINCE the French copper syndicate extended its contracts with the owners of American mines the daily press has turned its attention to this gigantic interest, and has advocated legislative enactments to restrict the operations of the monopoly in the United States. In an article in the Chicago *Times* of November 19th, treating of this subject, it says of the copper corporations: "The companies forfeit all claim to a continuance of government favor if they monopolize the mines to the injury of society. The private ownership of such property is permitted merely as a matter of public policy. It is allowed to encourage private enterprise in the discovery and development of valuable mineral deposits. Free competition in the sale of the products is one of the implied conditions upon which the policy rests. If free competition is stifled and monopoly set up in its place the fundamental condition is violated, and the government may resume the title. And it is not only the right but the duty of government to do so, if necessary, in order to protect society against rapacious conspirators."

HARD-HEADED Cyrus W. Field has become convinced that there is a great future before the electric motor. He is quoted as saying, "There is not the slightest doubt in my mind but the electric motor will ultimately be the means of deciding our problem of rapid transit." Mr. Field had in his mind the necessity of rapid transit in New York city.

THE phonograph has caused a sensation in theatrical circles in New York city. A stranger recently entered a box in the Casino with a telescope valise. Soon after it was discovered that he had brought a phonograph with him, and as the performance proceeded he patiently turned the little crank and recorded the music of the new opera. As soon as this fact was ascertained, the intruder was promptly ejected, and the telegraph states that his recording cylinders were confiscated. Did the impressario have a right to act so summarily? When the phonograph is put on the market this question will demand a solution. Thus far the legal status of the phonograph has not been established.

MR. ABDANK, before the American Institute of Electrical Engineers, paid both American electricians and the English language a very high compliment when he said, after an unnecessary apology for his lack of mastery of the English language, "I am of the opinion that every good electrician ought to be able to speak English. He cannot be a good electrician without being a complete master of that language. Without an intimate acquaintance with the works of Faraday, he is not able to draw conclusions in a simple and logical manner from experiments. He cannot, without being in direct communication with the legion of workers in electricity who speak the English language, and who have advanced electricity in this country to a point where it is fifty years ahead of that in Europe, I say, that without knowing it intimately, he cannot keep track of what can be done with that power of nature which we are all attempting to harness."

AMPERE'S services to science have been commemorated in two ways: By the adoption of his name, in 1884, at the Parisian congress as an expression for the unit of the quantity of a current of electricity, and by the monument unveiled October 9th last, at Lyons, France, and illustrated on the title page of this issue of the WESTERN ELECTRICIAN.

It is fitting that a graphic reproduction of the only monument to Ampere in the world should be placed before our readers, but there the interest ceases, inasmuch as the sculptor, as stated in these columns heretofore, chiseled, instead of the features of Ampere, those of an Apollo, as the statue was to ornament a beautiful square—a sacrifice of truth to art.

Ampere's name, however, lives in the daily conversation of all workers in electricity, and this tribute to his greatness is of far more worth than the untruthful, though artistic, work in stone at Lyons.

THE possibilities of the electrician's art are well exemplified in a recent feat accomplished by the telegraph. November 18th Lord Ennismore, heir to the earldom of Listowel, was lying at the point of death in the hospital, at Victoria, B. C., of typhoid fever, accompanied by other complications. Through the aid of Sir Donald A. Smith, who is in London, a telegraph circuit was formed from London to Victoria by the Mackay-Bennett cable and Canadian Pacific Railway telegraph, and Sir Andrew Clarke, the distinguished London physician, was placed in direct consultation with Dr. Hannington in Victoria. A conversation lasting three hours, concerning Lord Ennismore's condition, was carried on. An unbroken circuit was worked from Victoria to the cable office in New York, where the telegrams were repeated to London. Replies were received in three and four minutes. It is a pleasure to state that at last reports the patient was recovering, though still not out of danger.

THE rapidity with which a slang expression is carried to all parts of the country is marvelous. An apt bit of slang will be caught up and spread in all directions like wildfire. It seems to be more than likely that the introduction of the electric railway will give rise to a new claimant for popularity in this field. In Akron, O., where an electric street railway was recently installed, the citizens have grasped the idea that the cars are disabled when the trolleys are off the wire. The electrical expression has been transferred into common speech, and it is said that citizens are now frequently heard to remark by way of retort, "Oh, your trolley is off." In Akron it is said that persons are so fond of uttering this remark, that they engage in disputes in order to find opportunities for employing the expression. Since election many disconsolate residents have been taunted by the remark, "Your trolley is off now." To such base use is the electric vocabulary put.

THE proceedings of the American Institute of Electrical Engineers at their last meeting, so extensively reported in this issue, are of unusual interest and value.

Any one of the papers read presented thought enough to warrant devotion of the entire time at command to its discussion. As it was, three distinct and dissimilar subjects were brought before the institute, and an evening of rare entertainment was passed.

The Geyer-Bristol meter for either direct or alternating currents was very well described by Professor Geyer, one of its inventors. As will be noted, it utilizes the heating effect of a current of electricity to produce a mechanical motion, which in turn makes a record.

Mr. Abdank's integraph is a marvelous instrument, to say the least, and merits the compliments bestowed upon it.

The melograph and melotrope designed by the same gentleman for recording and reproducing the music of a piano, endows even a child with the ability to correctly reproduce the work of a master, the performer's sole office, when power is applied to the instrument, being to govern the melotrope when piano and fortissimo effects are to be brought out.

THE telephone controversy in Chicago is still unsettled. At the last meeting of the finance committee of the city council the matter was brought up for consideration, but no decisive action was taken. The Chicago Telephone company made a proposition to give the city 2½ per cent. of its gross income as consideration for its rights in the city; the company, however, refused to make any concessions in the matter of rentals to private subscribers. During the last week the press of Chicago has been making a point of a recent decision of the Supreme court in the case of the city against the Phœnix Insurance company. The case involved the right of the city to compel foreign insurance companies doing business in Chicago to pay a certain per cent. of their gross revenues. The court decided against the city, but it is asserted that from the decision it can be implied that the municipality might have regulated the price of a policy issued to an individual. It is held, of course, that the same reasoning applies to the regulation of telephone rates. A decision of the Supreme court is also referred to by the legal department of the city which affirmed that the regulation of warehouse charges was within the police powers of the state. The legislature has granted police powers to Chicago, so it is held that the right is vested in the municipality. Mr. Knight, assistant corporation counsel, is quoted as saying that, under the two decisions referred to and the Indiana telephone statutes, the city would win in a suit against the telephone company. It is to be hoped that matters will not be carried to this extreme. The telephone company has manifested a disposition to compromise the controversy, and the city officials ought to be able to make an adjustment.

American Institute of Electrical Engineers.

The American Institute of Electrical Engineers met on November 13th at 8 P. M., at the College of the city of New York, ninety members and guests being present.

In the absence of President Weston, on motion of T. C. Martin, Capt O. E. Michaelis was chosen chairman

The first paper of the evening, on "The Geyer Bristol meter for direct and alternating currents," was then read by the author. The paper is reproduced elsewhere.

PROF. GEYER added the following remarks: I will just for a moment call your attention to the instrument. You will see it has been recording for the time you have been here By the kindness of the authorities here I have been furnished with current which supplies a rack of lamps, and as I turn the lamps off or on you can notice that the pointer gradually goes down or up, leaving its record. The pointer does not respond instantly to changes of current, but as in actual use this record is spread over days, and in fact probably over weeks and months, this, I think, would not be a serious inconvenience. The clock that we have here at present causes that dial to rotate once in twelve hours. Of course, we might have a clock rotating faster or more slowly. If it had been convenient I should have gotten one where the dial moved much more rapidly.

DR. S. S. WHEELER: I would like to ask Dr. Geyer what is the effect of changes of atmospheric temperature on the instrument?

PROF. GEYER: We have experimentally tried to find out whether atmospheric changes of temperature did affect it by taking it in the winter time from an ordinary heated room into a hallway or passageway where the temperature was below freezing, and then passed the same current as current by another instrument through it without being able to detect any difference in the reading. It is the difference of the temperature in the two bars which counts, not the actual temperature of either one.

F. B. CROCKER: I would like to ask if the moisture in the atmosphere had anything to do with it. The same question arises in regard to the Cardew voltmeter I have never heard that question answered. Every moist day, for example, this bar which is intended to get hot loses its heat more quickly than it does on a very dry day. In other words, would the difference in temperature be greater on a dry day than on a wet day?

PROF. GEYER: On that point we have not made any experiments. I should judge from general principles, as it is simply the difference of temperature between the two bars that the case would be analogous to the case that I mentioned before putting the instrument into a warm room and then into the cold room; the moisture in the atmosphere if it has any effect, being simply only equivalent to increased heat, or increased cold around the instrument. Experimentally, I could not say what the results would be, although I should imagine they would be negative.

CARL HERING: I would like to ask whether it would make any difference with this instrument whether the current were direct or alternating?

PROF. GEYER: It would make no difference whether the current were direct or alternating. What we measured is the heating effect of the current. We say an alternating current is equal to a continuous current for all practical purposes when it produces the same heating effect.

In answer to a question by Dr. Vander Weyde, Prof. Geyer said: The instrument as shown here is intended only as an ammeter, although we believe a voltmeter can be made. In this case it is necessary to introduce very high resistance. That we think we can accomplish by causing the current in one of the parts not simply to come down, but to go back and forward a very great number of times. Thus, instead of the wire which grows hottest in our present arrangement, we take a very fine wire—which, of course, it must be to make a voltmeter of—and bend it backward and forward a great number of times, and then lay that as a flat disk upon the other strip, the other strip having the current passing through it or not passing through it, as may be desired.

DR. VANDER WEYDE: The objection to using the principle of expansion by heat as a voltmeter is that currents of a very small number of amperes have no heating effect. It is the amperes which cause the heat; the electromotive quality does not. For instance, in the old fashioned friction machine we have plenty of force; the electromotive force is very great. Prof. Mayer in a lecture at the Stevens' institute demonstrated that the number of volts of a static machine went up into the thousands. Now we know that a voltmeter has a very limited rate, and the range runs only for from 30 to 120, so a voltmeter based on the expansion principle has a very limited range, and in fact it is not a metallic thermometer calibrated for volts. If you calibrate it for amperes it may be very correct There is no doubt of it, because the amperes cause the heat. To prove that, you have only to take a battery which will heat a wire, and it has only one volt, while a battery of say thirty or forty Leclanché cells has some thirty or forty volts and will not heat the wire.

PROF. GEYER: Whether we say that it is the current that heats the wire, or the electromotive force that heats the wire, to my mind is a mere question of words, because we ordinarily understand that it is the electromotive force that makes the current, so we could say the current heats or the electromotive force heats.

The question as to whether Cardew voltmeters will record so many volts, or so many volts, is to my mind simply a question of proper adjustment of parts. Thus, for instance, at the Stevens' institute we had occasion last summer to measure directly the electromotive forces of a Westinghouse alternating machine. We wanted to measure, if possible, directly without any multiplying devices volts, say from 10—all we agreed to do was to go up to 500. We, therefore, constructed a voltmeter sufficiently long, in fact it was two stories high, and we had no difficulty whatever in getting very large deflections for 10 volts—that is as low as we cared to go, and we made our pointer go around nine times for 500 volts. To make no mistake in counting the nine turns we had a secondary dial, which as on a common clock rotated one division for each revolution of the other dial.

DR. VANDER WEYDE: There is a difference that is not in the mere volts; there is a difference in the nature of the electromotive force, and in the quantity of current. It is like water, where you have a great quantity of water and no pressure Water may come through a pin-hole when under pressure; then you cannot compare that with the volts. If we have no electromotive force the current cannot overcome any resistance, it may be ever so much. The thermopile can overcome scarcely any resistance. There we have an illustration of large currents and very small electromotive force, plenty of amperes and no volts; while in static electricity we have the reverse, low quantity and plenty of pressure.

PROF GEYER: I think all of these relations are usually expressed in the simple form of Ohm's law: $C=\frac{E}{R}$; and when we come to heating effects we can express them by what we call Joules's law, that the rate of doing work is equal to C_2R.

MR. MAILLOUX: I would like to ask Professor Geyer what is the rule or law or function of getting the deflection of the strip with the rate of current.

PROF. GEYER: In some respects it may be unfortunate that the deflections are not proportional to the current. It would hardly be expected. As we all know, the heating effect varies as the square of the current, so if I treble my current I have four times the heat produced, but then the bars will lose their heat much more rapidly when they are at a higher temperature. The deflections are not then as the square of the current, but as some intermediate function.

In reply to a question put by MR. WOLCOTT, PROFESSOR GEYER continued: The circuits drawn on this card are ampere circuits. Gentlemen can see from noting the relative distance of these concentric circles what the rate of increase is for increased current You will at once notice that at the outside of the disk the distance between two concentric curves is greater, that the instrument grows more and more sensitive as the amount of current on it is increased.

MR. CROCKER: I would like to ask Dr. Geyer a question, which I think has an important bearing on all meters, and that is as to the amount of current consumed by it, compared with the amount of current that it measures—that is to say, the efficiency of the meter. I think these meters, working by the heat produced—for example, Professor Forbes's meter, and, to a certain extent, the Cardew voltmeter—consume rather a large quantity of current in proportion to the current they measure. For example, when ten lamps are in circuit, we say ten amperes, I would like to ask Dr. Geyer what the drop over the meter would be in volts.

PROF. GEYEE: I agree with the gentleman that the question of resistance is a very important one indeed, and we have aimed to keep the resistance of the ammeter low. The resistance of the bars, which is there exhibited, is about .06 of an ohm. We believe it could be brought much lower, possibly by selecting other metals. Probably the length of the bar might also be much shortened. When I tell you the resistance of the instrument is so much, you can calculate at once for any given current what is the loss of energy in the meters as compared with the consumption of energy in the lamps or in the meter, as the case may be

DR. WHEELER: What is the ampere capacity of that .06 ohm strip?

PROF. GEYER: That strip will carry currents up to twenty amperes, and possibly greater. We have not urged it beyond that point.

DR VANDER WEYDE: You can make them to any capacity, of course

PROF GEYER: They can be made to any capacity by making the cross-section of the pieces greater.

DR. VANDER WEYDE: I confess that the low resistance is a great advantage in your arrangement.

PROF. GEYER: In the Cardew instrument, of course, great resistance is not an objection It has always, to my mind, been one objection to the Forbes meter, that it consumes relatively a large amount of energy. He uses a very small proportion of the heat produced to operate a little windmill. We might be said to use the whole heat produced.

MR. WOLCOTT: With regard to the voltmeter which was drawn on the board, the reason I asked the question was because it would require considerable length of wire, and I should judge the self-induction would be very high. That seems to be the trouble with using a straight wire.

PROF. GEYER: I think if the wire were wound zig-zag the self-induction would, for that very cause, be eliminated.

THE CHAIRMAN: Is there any further discussion? I see we have with us this evening Dr. Moses, and I am sure we should all be pleased to hear from him in regard to this very interesting subject.

DR. OTTO A. MOSES: I regret to say, gentlemen, that I came late this evening. The subject is a very interesting one. There are one or two questions that may be a little at random, but they are simply through ignorance, not having heard the earlier part of Professor Geyer's lecture Is there any superior advantage in having different radiating areas of the same metal over different radiating areas of different metals?

PROF. GEYER: The great point is that we have two metals whose co-efficients of expansion are equal, so that simple atmospheric changes shall not cause the bar to deflect. If then you select two different metals, which, however, have the same co efficient of expansion, it will not alter the action of the instrument. The object of getting more radiating surface is to get a greater difference of temperature between the one conductor and the other conductor.

PROF. MAYER: The whole question resolves itself into this: The instrument comes very soon into equilibrium, although we may have different metals, so that it takes three times as much heat to heat one as the other. The radiation of the instrument will depend entirely on the difference between the plate and the surrounding surface. So that this question does not enter into consideration in reference to the action of the instrument, so far as I can determine

DR. MOSES: Do you believe it is possible to keep the surface at the same equal degree of polish and in that way to be able to get equal ratios of radiation? Take German silver; the oxidation that will take place upon it from the increased radiating area of one side may in that way affect its accuracy after a while, may it not?

PROF. GEYER: I think it would affect the rate of variation to a slight extent. We propose to use such cross-section that the wire shall never lose its polish from simple heat generated in it. It would thus only lose its degree of polish gradually if subjected to severe treatment from without – say strong acid fumes. Ordinary atmospheric changes do not seriously affect German silver.

DR MOSES: In the case of alternating currents, have you considered the electric density, so to say, of the conducting body in relation to the differences of areas? That is a question that has recently been brought forward.

PROF. GEYER: I must confess my ignorance, and ask the doctor to explain what he means by electric density. Then perhaps I shall be able to answer.

DR. MOSES: I mean by that the fact that in conductors of different areas of cross-section there have been found to be certain parts that by an electromotive force set up within the body of the conductor itself, like the central part of rods in mechanics in strains that do not have the same ratio of conductivity, owing to the sudden alternations of the current; the current not seeming to be able to permeate, as it were, to the center. This difference in area might in some way or other affect the amount of current that would pass over the conducting wire and surface, and in that way somewhat affect the heat radiation.

PROF. GEYER: I can only answer as far as this: I have lighted lamps with a continuous current and noted the deflection of the instrument, then heated them up to the same degree of brightness as measured on the photometer and noted the deflection when they were lighted by an alternating current of 16,000 alternations per minute, and could notice no difference in deflections.

The chairman then introduced Mr Abdank, who read a paper on "Some theoretical considerations with respect to the Abdank magnetic call," reproduced elsewhere.

PROF. GEYER: I would like to ask whether, the current being an instantaneous current, it was attempted to make any corrections for the self-induction of the galvanometer coil. As I understand it, the current was a momentary current.

MR. ABDANK: The current was relative to the period of oscillation of the needle.

PROF. GEYER: What I meant was whether the current really had time to develop its strength as to its electromotive force.

MR ABDANK: The difference would be small.

PROF. GEYER: I was more particularly interested in the subject because somewhat analogous experiments were made under my knowledge, where it was attempted to measure the current of the electromotive force of an alternating machine where the alternations took place at the rate of 16,000 a minute, and it was there done by causing the condenser to be discharged and then at pleasure discharging it also through a ballistic galvanometer.

MR. WOLCOTT: Having been for some time interested in the study of integrating machines of various kinds, and having invented some myself, I can say that I never have seen anything which will approach this instrument. The ordinary type of integrating machine which Mr Abdank has spoken of will simply give a reading at the end of a given time – simply a single reading of the integral available. All who have given any study to the subject are familiar with the apparatus of Prof. James Thomson, Sir William Thomson's brother, which will integrate any expression involving a single variable. It is simply a disk and a sphere in a cylinder. The distance of the point of contact of the sphere from the center of the disk will represent the variable quantity; that is the function, and if this distance can be made to follow any required law of motion, and that point of contact of the disk is transmitted to the circumference of the cylinder which is uniform the whole length, it is evident that the motion of the cylinder is proportional to the distance of the sphere from the center of the disk This apparatus, in combination with others, will also integrate differential equations. I do not think there is any apparatus like this which will trace one curve, the ordinates in which are integrals of the ordinates in the other curve.

CARL HERING: I would like to say in behalf of Mr. Abdank that one of the features of that instrument besides tracing the integral curve is that it can be used for solving numerical equations which, I understand, cannot be solved algebraically—equations of a high degree, 4th, 5th and 6th degree. The instrument will trace out a curve the dimension of which will give the values of equations of high degree.

MR. WOLCOTT: Does that give all the real roots in one curve?

MR ABDANK: Yes.

PROF. MAYER: If the machine will do that it is a marvelous production of ingenuity and science. Charles Babbage, of England, gave his whole life to making a calculating engine. After he had perfected his differential engine and the British government would not supply him with means of bringing it out, he invented an analytical engine of which you will find a description by the only daughter of Lord Byron, Lady Lovelace, which did just what this does. The construction of it would be so difficult that Babbage had not the means of bringing it out. If a machine so simple in its construction will do that, I can see that it is the most marvelous production of this age. I would like very much to understand it. Of course I only see it there and I know nothing of its principle.

THE CHAIRMAN: I understand, Mr. Abdank, to put it in plain language, in solving any equation of the second

degree the instrument would describe a conic section and higher curves according to the nature of the equation.

MR. ABDANK: Yes [The speaker put an equation on the blackboard.] Then I leave out the equation of the first degree. The equation of the first degree represents a straight line. Then I could have integration with the instrument, in opposite directions. The first curve would be a parabola, and repeating that several times I arrive at a curve that will represent the first equation and then I have all that I want by the intersection of that curve with the axis of the abscissæ. I have here in my book the solution of one of these equations and the solution of the equation of third degree only. [The speaker copied upon the blackboard the equation from his book.] I know the calculating machine of General Babbage very well. My instrument acts in a different way. The machine of General Babbage is only an arithmetical machine. It has nothing to do with differentials.

MR. WOLCOTT. There is one more question I would like to ask Mr. Abdank. As has been said, there are plenty of machines for performing integrations with respect to a single variable. So far as I know there has never been a double integration: that is, one integration with respect to two independent variables, performed by mechanical means. I do not see how it is possible.

MR. ABDANK: It is possible in special cases.

THE CHAIRMAN: Is there any further discussion? If not we will proceed to the next paper on the programme, for which we are also indebted to Mr. Abdank, but a description of it will be given by our fellow member, Carl Hering of Philadelphia. As I understand, it is a combined electrical and musical stenographic recorder and typewriter. [Laughter.]

MR. HERING described the instrument as follows:

The apparatuses I will describe are the melograph and the melotrope. The melograph is an apparatus for recording what has been played on the piano, and the melotrope is an instrument for reproducing this music from the record made by the melograph. The melograph consists of a system of contact points or keys, which are fastened under the key-board of a piano and are so arranged that when a key is depressed the contact is closed. These keys are then connected to an instrument like the ordinary Morse ink recorder so that when each key is depressed the mark will be made on a strip of paper corresponding in position to the position of the note on the piano, and as each note is represented by a key and by corresponding recording apparatus each note will, on being played, be recorded on a strip of white paper like this, in the form of a dark line which perhaps you can see. This paper is therefore a record of the notes that have been played by the player. It not only records the notes that were played, but the length of the line records the time during which that note has been held, so that it is not only a record of the note itself, but of the time of the note. This record is then passed through an intermediate apparatus called a perforator, the object of which is to perforate a piece of stiff paper with rectangular perforations corresponding to these lines of the melograph record. This is done by means of an electric apparatus which consists of a little square punch which travels up and down very rapidly. It is driven by an electric motor. I understand the lines on this paper are first run over with a puncturing pin. Then this paper is passed over a series of contacts. Whenever the paper is punctured connection will be made which connection will work this little punch at a place corresponding exactly to the place of this line on this record. In other words, this record on stiff paper is an exact counterpart of the other only that it is perforated with smooth rectangular holes, whereas this is originally merely a written record. This record is then ready for the melotrope—the reproducing apparatus. The melotrope is merely mechanical in its action. It would be rather difficult to explain it without models, but I will try to give a short description of the essential parts of it. The idea of the inventor in designing the reproducing apparatus was to imitate as nearly as possible the motion of the finger. In ordinary mechanical piano players the fingers are merely depressed by the strings. The force with which they come down is constant, and in short the whole apparatus is very mechanical in its action; but in this case the inventor has tried to imitate the motion of the finger; in other words he has tried to depress the keys softly, gently or with considerable force, to hold them down a longer or shorter time. Now this is accomplished in the melotrope, which is the apparatus Mr. Abdank will exhibit by means of a long roller which extends over the length of the key board which is to be played upon. This roller has cut into it a number of grooves the sides of which are slightly inclined. In this case the instrument is arranged for three octaves. There are 37 notes to be played. There are therefore 37 of these grooves. In each one of these grooves there is wound a turn or two of a cord. To show this I will draw the end view of this roller [making a sketch]. Imagine that to be the cross section of the roller. There is a string running around once or twice. The end of this string is fastened to the finger which is a little cylinder which moves up and down. These [indicating] are the little fingers referred to. When this roller is being turned constantly in one direction—when that string is tightened it will pull this finger down. This finger rests on the keys, so that whenever this string is tightened this finger will be pressed down. The tightening of this spring is performed by a mechanism which I will not attempt to explain now. It will suffice here to say that it is a little wedge which is run into this groove. That little wedge is actuated by levers which run over this paper. Wherever they come opposite to a hole this little lever passes through the hole. In passing through the hole that end of the lever makes a motion which is transmitted to this little wedge. The wedge is pressed into this groove. That tightens the string and pulls down the hammer. So that whenever there is a hole in this record that corresponding wedge will be pushed into that corresponding groove which will tighten that string and will press down the key and will hold the key down as long as there is the hole in this paper. I hope I have made that clear. It is very difficult to describe it without a model.

I am told by a pianist that the pressure exercised by the finger in playing is sometimes as much as five pounds; so that these little fingers must come down each with a force of five pounds, and I understand that they can come down with greater force than that because this apparatus can play even louder than a person can play. I might add that the apparatus does not produce piano and fortissimo effects. Wherever piano should be played and wherever fortissimo should be played it is written on the music and the effect of piano and fortissimo are produced by a little lever on the side of the instrument. This little lever does nothing more than run these wedges toward the roller or from it. If it moves them toward the roller it is evident that the force with which this would be moved down would be much greater. If they are pulled away the force with which this comes down is much less. This apparatus is only a model so that you will notice the want of a full bass. It can just as well be constructed for seven octaves.

DR. VANDER WEYDE: How does the electricity act on that written paper?

MR. HERING: It is punctured with a puncturing pin. It is necessary to go over this by hand.

DR. VANDER WEYDE: It is just as easy to punch those holes. I can just as easy make those holes as puncture them. If it was an insulated paper with a conductor then you could make and break contacts with an electrical apparatus.

MR. HERING: It is necessary to go over this by hand for this reason: Every player, however expert, will touch notes that he ought not to touch. They will be all recorded by this apparatus, and it is necessary to have some one go over and erase those notes.

DR. VANDER WEYDE: I beg your pardon, good players will not touch notes which they ought not to touch.

MR. ABDANK then played on his instrument the overture from "Carmen," and afterward the "Boulanger March."

MR. HERING: There is something about this which will interest those of you who are musicians; you all understand that the notes are represented by certain positions on this paper. Therefore, if you reverse this paper and pass it through the apparatus the wrong way, the notes would be entirely different. A note which is three spaces above would then be three spaces below. The effect is rather curious. We will try it first and discuss it afterward. The piece is the minuet from "Don Juan." It will be played first the right way.

MR. ABDANK then played the minuet from "Don Juan."

DR. VANDER WEYDE: Now play it backward.

MR. HERING: It will sound like Chinese music played backward. As just played it was in minor, while the other way it was in major, and the chords were perfectly correct.

MR. ABDANK then played the piece backward; he also played a piece improvised especially for the melotrope. The improvisation was written in his laboratory and converted in one hour after he played it into the form ready for the melotrope.

DR. MOSES: Would Mr. Abdank be so kind as to reverse the last piece? My object in asking is to see whether the reversal of a piece cannot be the most accurate criticism of its correctness. It is a most interesting fact that music reversed in that way will produce a pleasant impression upon the ear. There is an analogous fact which any one who will take the trouble to try that may bring some light to bear upon it. If you take a piece of paper and write simultaneously with both hands in opposite directions, then reverse the one that looks written backward and look at both holding the object between the eye and the light so that the two writings will seem to be then in the same direction, you will find that they are written by the same hand. Now the reversal of music indicates correctness of the thought and the harmony in the first direction. And it may be possible in that way to discover an accurate method of criticising the correctness of harmonies, or in other words, what should be heard. There is some music which takes a very considerable musical education to appreciate. If that music when reversed becomes harmonious then it is worth being heard perhaps.

DR. VANDER WEYDE: Allow me to remark that if you turn a perfect chord upside down it becomes a discord.

DR. MOSES: But every discord becomes a chord in its proper place.

DR. VANDER WEYDE: But it is not in its proper place if you turn it upside down.

DR. MOSES: It is a very amusing thing to listen to the analysis of sound on the phonograph, and it is not impossible that one by education could read it backward as the printer reads his type backward.

MR. HERING: This is not backward, but right side left.

MR. ABDANK then played the improvisation in the reverse way.

A MEMBER: Perhaps we have now discovered why Chinese music is more correct than our music, just as their nomenclature of the poles of the magnet.

THE CHAIRMAN: I would ask Mr. Abdank whether it is necessary that the motor of the crank should be an intelligent one.

MR. ABDANK: No, Mr. Carpentier generally uses an electric motor. The motion of the crank is absolutely uniform and any one of you here could play those pieces the same as I can.

MR. HERING: The piano and fortissimo are operated by the player, but the player's action is purely mechanical.

DR. MOSES: Can you produce a crescendo with it?

MR. ABDANK. Oh, yes very easily.

THE CHAIRMAN announced that at the next meeting which will be held on the 18th of December, through the courtesy of General Webb and Professors Compton and Doremus, "we will have the same facilities at the college that we had to-night for the experimental illustration of the subject, a paper will be read by W. J. Jenks, a member of the institute and present director of the Edison Standardizing Bureau. His subject will be "Six years' experience with the Edison chemical meter."

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 15.—At the meeting of the Board of Electrical Control, held November 13th, permission was granted to the Western Union Telegraph company to string temporarily on existing poles four 50-wire cables from the City hall station of the Third avenue elevated road to 195 Broadway, and thence to the down town exchanges. The reason for the granting of this permission is the fact that cables placed in the subways of lower Broadway are liable to destruction by the extreme heat from the pipes of the Steam Heating company, as previously stated. The board has been advised that the Steam Heating company can be enjoined, but on account of the importance of the steam service it appears doubtful if this course will be persisted in, although Secretary Moss was instructed to communicate with the corporation counsel, and request his co-operation, it not being clear who the proper person is to bring proceedings against the company. The new rules framed by Dr. Wheeler, which have been under consideration for some weeks, were adopted, and will take effect next Monday. These provide for the general regulation of overhead wires pending the construction of the subways, and hereafter permits will be granted under their provisions. The secretary was directed to inform all companies having conductors in streets where subways have been provided to remove them within 90 days, else they will be proceeded against in the form approved by the corporation counsel. In accordance with a resolution offered by Commissioner Gibbons, President Hess was appointed a committee of one to wait upon Mayor-elect Grant, and tender the congratulations of the board upon his election by so magnificent a majority, and invite him to attend a meeting of the board at his convenience, and acquaint himself with its doings.

An injunction against the board was granted by Justice Lawrence of the Supreme court on Monday in behalf of the United States Illuminating company, restraining them from interfering with the lines of the latter until a suitable subway had been provided, and from all acts tending to the granting of privileges to the Metropolitan Telephone and Telegraph company, the Western Union Telegraph company, and the East River Electric Light company. A motion to continue the injunction will be argued in a few days. The company claim that since last June they have been hampered in every possible way, and discriminated against by the board, and that in consequence they have lost 150 subscribers in the Broadway district. They can neither put up new wires nor repair the old ones.

At a meeting of the Medico-Legal society at Hotel Buckingham last night a report was presented from the committee appointed last September to consider and advise upon the proper method of executing criminals by electricity. It was signed by Frederick Peterson, J. Mount Bleyer, Frank H. Ingram and R. Ogden Doremus. After reviewing the results of various experiments upon dogs, and alluding to the necessity of providing against any disfigurement of the body, the report concludes with the following recommendation:

"After mature deliberation we recommend that the death current be administered to the criminal in the following manner: A stout table covered with rubber cloth, and having holes along its borders for binding, or a strong chain, should be procured. The prisoner, lying on his back or sitting, should be firmly bound upon this table or in the chair. One electrode should be so inserted into the table or into the back of the chair that it will impinge upon the spine between the shoulders. The head should be secured by means of a sort of helmet fastened to the table or back of the chair, and to the helmet the other pole should be so joined as to press firmly with its end upon the top of the head. We think a chair is preferable to a table. The rheophores can be led off to the dynamo through the floor or to another room, and the instrument for closing the circuit can be attached to the wall.

"The electrodes should be of metal, not over one inch in diameter, somewhat ovoidal in shape, and covered with a thick layer of sponge or chamois skin. The poles and the skin and hair at the points of contact should be thoroughly wet with warm water. The hair should be cut short. A dynamo generating an electromotive force of at least 3,000 volts should be employed. Either a continuous or alternating current may be used, but preferably the latter. The current should be allowed to pass for thirty seconds."

The Board of Trade and Transportation at its meeting yesterday appointed Simon Sterne, Isidor Straus, W. D. Stewart, Frank O. Herring and Jeremiah Fitzpatrick as a committee to prepare a bill for the legislature regulating the charges for telephone service. The resolutions recite that telephone charges in New York are twice as high as in other cities, and that a powerful lobby at Albany has thwarted all efforts to prevent the extortion.

Chas. Watson, an electric light trimmer in Brooklyn, while replacing a carbon in a lamp at Prospect park reser-

voir about two o'clock Wednesday morning, received a shock which caused him to fall to the ground, a distance of 18 feet, causing serious injury. He was removed to the City hospital.

A report has reached this city to the effect that a general strike of railroad telegraphers in Texas is expected if the proposed reduction of 10 per cent, is enforced on the Gulf of Colorado and Santa Fe R. R. It was stated at the railroad telegraph superintendents' meeting in July that operators are not plentiful in Texas, so it appears probable that some compromise will be effected. P.

Kansas City, Mo.

KANSAS CITY, Mo,, Nov. 16.—On the 9th and 10th insts. a section of country embracing parts of Missouri and Kansas was visited by the first snowstorm of the season, and a disastrous visitation it proved. The telephone exchanges of the Missouri and Kansas Telephone company at Topeka, Lawrence, Leavenworth, Atchison and St. Joseph suffered seriously. The storm passed about twenty miles west of Kansas City, and the exchange here escaped. The greatest damage was done at St. Joseph, where 300 wires were broken down and two cable poles broken off at the top. Atchison had over 200 wires down, Leavenworth about the same number, Lawrence 100, and Topeka 100. Nearly every one of their extensive system of toll lines was broken, and in places the poles were broken off. An extra force of men was immediately put to work and the toll lines were all in operation by Tuesday, the 13th.

At St. Joseph all day Thursday, the 8th, the rain and mist descended in fitful gusts. Early Friday morning the mist resolved into a sleet, and within two hours there was another change, this time into heavy snow. Slowly, steadily, with a persistency worthy of something better, the snow came down all day until there was a fall of eight inches. The rain and mist had made the ground very wet, and as the snow fell it gradually banked up in pile after pile of slush. The snow being so damp, accumulated upon the telegraph, telephone and electric light wires until the weight became so great that many of them broke, striking pedestrians and causing no end of trouble and confusion. One telephone wire broke and wrapped itself completely around a lady passing, frightening her very badly.

George McDaniel of St. Joseph—a brother, by the way, of C. W. McDaniel of the Missouri & Kansas Telephone company of this city—is an employe of the company at St. Joseph. Friday morning while at work, attempting to replace fallen wires, he noticed that a telephone wire had broken and had crossed circuit of the Union Electric Street Railway company. He saw a team of mules approaching and called to the driver to stop, but the latter, not understanding, drove on, and the mules, becoming entangled in the wire, were thrown down and commenced to bleed at the nose. McDaniel went in a store to get a hatchet to cut the wire, and as he came out the wire, which at that instant was broken by the struggles of the mules, dropped around his neck. He says, after the wire struck him on the neck, he remembers nothing except of starting to fall forward. He fell on his face, which was badly bruised. The wire wrapped around his neck under his ears and burned a crease all the way round, burning the hair into the flesh. He was unconscious for an hour and a half. Two other persons received shocks from the same wire Your correspondent learned from the manager of the St. Joseph exchange that about twenty bells were burnt up, one cable box set on fire, and several switch-board drops burned out by telephone lines crossing the motor wire. The street railway system in use is the single overhead wire with the return through the rails and the ground. The cars ran during the storm except for a short time when the current was shut off at the request of the telephone company No damage of any importance was done to the circuits of the motor line. W.

KANSAS CITY, Mo., Nov. 17.—The affairs of the Exposition company are in a critical condition, and the probabilities are that the electric light company will have to take back its plant as the only pay for furnishing it.

The Western Electric Construction company, M. E. Bates, manager, has secured the contract for the new 1,500 light alternating plant at Wichita, Kan., and will begin work at an early date. The company has about finished its work on the plants at Fort Scott, Kan , and Pine Bluff, Ark As soon as the building is a little further advanced, the company will begin work on the electrical construction of the Edison plant in this city.

The Edison company has begun work on its subway, two miles of which will be built.

The Electrical Supply company of Chicago, represented here by Charles H. Cone, will establish a large wareroom here.

The Western Electric company of Chicago has had representatives here during the past week negotiating with Chillicothe, Mo., parties for the establishment of an electric light plant at the latter place. It is reported that the contract was closed for a good-sized plant.

The Kansas City agency of the Brush company will, it is understood, be consolidated with the St. Louis agency

Thomas B Doolittle of Boston, special agent of the American Bell Telephone company, has been here during the past week on business with the Missouri & Kansas Telephone company.

W. J. Buckley, representing the Fort Wayne Jenney company, and F. W. Horne, representing the Excelsior company of Chicago, were in Kansas City this week.

The Inter-state Electric Light company will establish substations of accumulators, to be charged from the dynamos at the central station. It is thought now that the central plant will be ready to go into operation by December 1st, with all the sub-stations also in operation. The delay has been caused by the inability to secure accumulators

In the suit of Waldy Thompson, deceased, against the Western Union Telegraph company, the court defined an exception in a telegraph company's liability for the statutory penalty for giving false information concerning the transmission of telegraph messages. Thompson, one Sunday, sent a telegram from Kansas City to J. H. Bothwell, at Sedalia, stating that if the message could not be sent at once it would do no good to send it later. The operator said he could send it at once, and failed to do so. Thompson sued the company and was awarded $100. Judge Hall, in rendering the decision, said: "Ordinarily, the defendant would be liable for the statutory penalty, but the applicant asked that the dispatch be sent on Sunday, which is contrary to the statutes, except in cases of necessity. This message was no case of necessity. Judgment is reversed, and the petition dismissed."

It is learned here that the Booneville, Mo., Electric Light company will put in a Ball plant.

T. F. Clohesy, the manager of the Kansas City office of the Postal Telegraph company, was the only republican elected of the four candidates for the legislature in this county. Mr. Clohesy is emphatically a self-made man. He was born in 1855, at Spring Valley, Green county, O , and is therefore 33 years old. He lived there until he was 25 years old. He began to work for a living in 1867, when only 12 years old, and his first job was carrying water on a wood train on the Lake Shore road in 1867. That was when railroads burned but little coal and an immense quantity of wood in running their trains Subsequently he worked as a messenger boy, and eventually learned telegraphy. Before he was 15 years old he was operator and station agent at a town on the Lake Shore road. He is a fine operator, and has worked in every office from Dayton to Toledo, and from Toledo to Chicago. He left the Lake Shore road in 1873, and in 1880 he came to Kansas City as chief operator of the American Union Telegraph company, which had an existence of one and one-half years He was afterward connected with the Mutual Union, and later with the Home Telegraph & Signal company. Mr. Clohesy has never held a public office, and did not seek a nomination for representative. In fact, he did not know ten minutes before he was nominated that his name would go before the convention.

The patent office has notified Chief Hale of the acceptance of his petition for a patent upon his telephone fire-alarm box. The notification remarks that Hale's invention, giving direct communication with the fire department by means of telephone instead of through the central office, is the first thing of the kind in the field. There are only twelve of these instruments in Kansas City at present, but their use will be extended as quickly as possible. An application has also been made for an English patent. P.

London, Eng.

LONDON, Eng., October 31.—The WESTERN ELECTRICIAN of September 29th contained a description of the Waterhouse system of regulation, which is apparently a step in the right direction for obtaining that which we all have long desired to secure, viz: A system of regulation which would lend itself, as it were, to the requirements of work to be done at variable pressures of current absorbed in the circuit under changes of work and energy consumed at the lamps; therefore your description of the Waterhouse system has been one of considerable interest to the English engineers.

We would also point out that your correspondent, O W. Ditsch, has fallen into a slight error as to the make of incandescent lamps used in Germany. He mentions the Brush-Swan and Vitrite lamps as generally used in Germany. This is an error, for the lamps he saw fitted with Vitrite caps are manufactured by the Seel Lamp company, for whom we act as agents for the sale of Vitrite caps in Germany. We have supplied over 100,000 during the past few months, therefore we are in a position to know.

The large high candle power and fancy colored lamps used and sold in Germany are manufactured and sold by us under the Zanni-Shippey patents. We think it only right to mention this fact, as credit should be given where credit is due. The remarks of your correspondent respecting the large works of the Actien Gesellschaft für Electrische Gluhampen, in Chaussee Shasse, Berlin, owners of the Seel patents, are quite correct, for this company turn out some thousands of lamps for the simple reason they make the best lamps in the trade at the price, and as the Seel patents are entirely free from the claims of other inventors, they command most of the trade in Germany and Austria, in which countries this lamp is largely used. SHIPPEY BROS., Limited.

Indianapolis Items.

INDIANAPOLIS, Ind., Nov. 15.—L. K. Bacon, representing eastern parties who have subscribed the money for building the McNeal electrical street railroad, is in the city looking the ground over. He reports all the money subscribed and the company ready to begin work, but before it begins it asks that the ordinance be changed so that it may know what amount of its receipts must be paid to the city. Another clause in the ordinance is not perfectly satisfactory to the company; it is the furnishing arc light at each street crossing for $30 per year, while the Brush company is to be paid $60 per year for the same service.

The Brush company is pushing its work now, setting poles, preparatory to furnishing street lights, as per contract with the city. Among the streets on which it has set poles is Meridian, one of the most fashionable residence streets in the city. The poles are set among fine shade trees the full length of the route, and are large and crooked. This has created quite a disturbance, and it is probable the company will be enjoined from stringing wires on them.

The trustees of the Young Men's Christian association have contracted with the United States Electric Lighting company for a small plant to light their building. There are to be 100 sixteen candle power incandescent lamps, besides a number of arc lights. The saving in gas bills for the first year will pay for the plant.

An ordinance for the location of incandescent electric light wires, introduced six weeks ago, came up before the board of aldermen, in special session, last night, and was reread. After being amended to read, "All wires shall be put under ground," it was referred to the committee on light. M.

St. Louis, Mo.

ST. LOUIS, Mo., Nov. 16.—The Missouri Electrical society held its first regular meeting last evening. The society adopted a very liberal constitution and elected officers for the ensuing year, as follows: D. J. Harris, president; S. P. Baird, secretary, and E. M. Edwards, treasurer. The society will meet every two weeks. It will light its hall with incandescent lights, the current for which will be supplied by accumulators.

The St. Louis Electric Accumulator company, D. J. Harris, manager, is furnishing its offices in the Commercial building in fine style. It will have a model accumulator room adjoining its offices. The accumulators in this room will have a capacity of 300 ampere-hours at 110 volts.

The Postal Telegraph company will soon be in its new quarters in the Bank of Commerce building. The company is putting in all of its work in good style, and to stay. This is a good location.

S. P. Baird is installing for the St. Louis Western Electric Light company a miniature electric railroad in a window of the Penny & Gentles Dry Goods company. The track will be 60 feet in circumference, the cars 18 inches long, 5 inches wide, and will make three round trips a minute.

D. W. Gurnsey, of the St. Louis Electric Power company, reports the sale of a 75 light Ball plant to Kirksville, Mo.

The Electric Power company is branching out in all directions installing motors in various buildings. B.

ST. LOUIS, Mo., Nov. 17.—During a heavy thunderstorm last week lightning entered the private office of General Passenger Agent Townsend of the Missouri Pacific railroad, and cut some queer capers before concluding to make its exit. It jumped on to the big glass door separating his office from that of his chief assistants, and in one flash made a complete map of the great Missouri Pacific system, as accurate in all details and respects, Mr. Townsend says, as if drawn by the steady hand and under the keen eye of the expert draughtsman. He expected to see the glass shivered to fragments, but, strange to say, it escaped with only a crack. After leaving the door it jumped over to Mr. Townsend's desk, and, he says, for an instant the sensation he experienced was the same as if some one had been sticking needles into him. He considers it a very remarkable coincidence, and says in future

lightning will have no terrors for him. He thinks himself proof against its fiery darts.

The case of the American Bell Telephone company *et al. vs.* the Evans & Howard Fire Brick company was dismissed in the United States Circuit court by the complainant at the defendant's cost. Some time ago an injunction, pending suit, was granted to the American Bell Telephone company, restraining the defendants from operating a telephone which the complainant alleged was an infringement upon their patent. The complainant agreed finally to dismiss the case, the defendants to pay the costs incurred by the suit.

President John Scullin of the Union depot and other lines has returned from another trip east, made for the purpose of investigating electric railways. Mr. Scullin's investigation was very thorough, and covered a great deal of territory. Last spring Mr. Scullin gave the Wharton company an order for a car with storage battery and motor, to cost about $5,000, and to be delivered before the democratic national convention, in order that it might be given a practical test while the season was good and the city crowded with visitors. The delivery was delayed from time to time, until a few weeks ago Mr. Wharton consented to allow the motor to leave his shops. The winter season then approaching, Mr. Scullin declined to take the car Mr. Wharton agreed with him that it would not be a fair test, and preferred to hold the car until spring, by which time he will have completed another storage battery, on which he is now working. Y.

THE ELECTRIC LIGHT.

The Greenville, Miss., electric light plant is now in operation.

An electric light plant will be established at Fort Leavenworth, Kan.

The electric light station at Montezuma, Ia., will soon be in operation.

The Van Depoele company has sold a 100 light incandescent plant to William Schmidt, Clybourne avenue, Chicago.

W. A. Foote & Co. of Battle Creek, Mich., have bought a 35 arc light plant of the Thomson-Houston company, Chicago.

The Badger Illuminating company of Racine, Wis., has purchased a 20 light arc plant of the Thomson-Houston company, Chicago.

The Denver Electric Illuminating company of Denver, Col., has purchased a 70 arc light plant of the Thomson-Houston company.

The Thomson-Houston company of Chicago has sold a 50 light arc plant to the People's Electric Light & Gas company of Canton, Ill.

The Dolbeer & Carson Lumber company of Eureka Col., has purchased a 20 light arc outfit of the Thomson-Houston company, Chicago.

The Pendleton Electric Light & Power company of Pendleton, Ore., has purchased of the Thomson-Houston company, Chicago, a 50-light arc plant.

The Thomson-Houston company of Chicago has sold to the San Joaquin Improvement company of Stockton, Cal., an incandescent plant to be installed on a coast steamer. The steamer will also be provided with electric search lights and head lamps.

An English paper says: The progress which is being effected by electric light companies in every part of the country becomes more marked every day. Even in the south of England, where, with a few exceptions, the gas monopoly has not been seriously shaken, there are signs of a great advance in the near future.

The resolution to award the contract for installing an electric light plant for $111,725 to the Indianapolis Jenney company, came up in the council of Allegheny City, Pa., November 8th. After considerable discussion the matter was sent back to a committee, with instructions to readvertise for bids on the rental basis, the city to have the right to purchase the plant at a fixed price, less the wear and tear; the wear and tear to be decided by three experts, one of whom the city should name, another the company, and the third by these two.

Said Alderman Landon, chairman of the committee on electric lights of the Chicago city council: "We want to do as much as we can with what money we have, and will show the people of Chicago the results on Christmas Day. We want every one to see what a profitable way it is to spend money, and will, in the spring, ask for an appropriation of $100,000 to extend the system. There is no other possible way in which we can break the back of the gigantic Gas Trust with which the city is being ridden to death. People only need to see how much can be done with a small amount of money to be in favor of the extension of the system. Wait until Christmas, and you will see for yourself."

The following interesting paragraph is taken from a Burlington, Vt., paper, of November 1st: There was a hearing before the judiciary committee of the senate yesterday in relation to a general law which is proposed to place electric light companies in the same relation to each other and to the public, as the law of four years ago did for the telephone and telegraph companies, namely, placing the location of line poles under the direction of the selectmen and boards of aldermen of towns and cities, and compelling the joint use of poles. A law which was intended to give electric companies the same privileges was passed two years ago, but through a clerical error it did not do so. It is now proposed to enact the same law without the error, but its passage is opposed by the Burlington Gaslight company, and the hearing at Montpelier yesterday was to give those who favored it and those who opposed, a chance to be heard. The Citizens Light & Power company of Burlington were notified that the bill would be opposed. The ground on which the new company wish the bill to pass, as we understand it, is that electric lines should be put in control of the board of aldermen and that one line of poles should be used by both companies, thus reducing the number of poles in the streets, and lessening the danger.

Of spectacular displays probably one of the most successful ever put upon the stage is that given at the end of the new ballet which was presented for the first time on Wednesday last at the Empire theater, says the London *Electrical Review*. Much of the effect is due to a use of the electric light on a scale considerably in excess, we believe, of anything hitherto attempted in this way. Each member of the *corps de ballet*, to the number of fifty-eight, is supplied with a small electric lamp in the hair, attached by a comb, the current being derived from a primary battery of four cells, measuring about 3½ inches by 2½ inches, and weighing under 3 pounds, which is secreted at the waist.

A Berlin correspondent writes: The work done by the Edison company in this city is so good that the public and the municipal authorities have perfect confidence in their ability to extend their central station work still further, and a concession has been given to this company for the establishment of two new stations—one in the center of the town and the other in the southeast quarter, where most of the engineering works and other factories are situated. Both stations must be ready within two years, and each must be able to supply current for 6,000 glow lamps burning simultaneously. The station in the center of the town will eventually be increased to a capacity of 24,000 lamps, and the other station will be increased to 12,000 lamps, the annual increase to be not less than 6,000 and 3,000 lamps respectively. All the cables required in connection with these stations must be in position by the end of 1892, and the supply of current within both districts will be compulsory, provided the customer is willing to take the light for at least one year. The network of cables to be laid down in connection with these stations is very complete, and practically comprises all the streets of the respective districts, some small and unimportant side streets alone excepted. In view of this extension of their business, the Edison company propose to increase their share capital at present by £150,000, and later on by £300,000. The electric light installation in the Monopole hotel of this town, which comprises 1,000 lamps, will shortly be in action. The work has been executed by the Berliner Maschinenbau-Actiengesellschaft, under the superintendence of Herr Beringer. The current is supplied by two 80 horse power dynamos, each direct coupled to a twin engine. The dynamos are of the eight-pole disk type, and are compound wound. Steam is supplied by two Babcock & Wilcox boilers, having collectively a heating surface of 2,400 square feet.

THE ELECTRIC MOTOR.

The electric railway at Alliance, Ohio, will probably be in operation in a week or ten days.

Over $25,000 is being expended in the experiment on the Short Electric Motor, on the St. Louis Street Railroad in South St. Louis. The power house alone will cost $8,000

The Thomson-Houston company of Chicago, through Theo P. Bailey, manager of the railway department, recently took a contract for the equipment of the Topeka road. The original contract called for the construction of fourteen miles of road, but the mileage has since been increased to sixteen and one-half The power will be generated by an 800 horse power Reynolds Corliss engine. Twenty cars will be operated at first, and the number will be increased to fifty in the spring. The electric motors will displace on this road steam dummies as well as horses.

There are now in Harrisburgh, Pa., five Sprague motor cars, operating over five miles of single track, some of them being in operation for eighteen hours out of the entire twenty-four. During the month of September last the receipts on this road were $3,600. During the same time the total operating expenses of the road, including all attendants, repairs, oil and waste, dynamo and motor men, salaries, insurance and other charges, of every description, amounted to only $1,200, leaving for the month a net profit of $2,400, or over 30 per cent. on the capital stock per annum. So well satisfied are the managers of this railway with the electrical equipment that they have ordered an additional equipment to supplement the one they now already have. Among the other railroads which have ordered additional equipments from the Sprague company are the Wilmington City Railway company, the St. Joseph U. P. Railway company, and the Wilkesbarre & Suburban Railway company, at Wilkesbarre, Pa.

Dr. A. Everett of the East Cleveland street railroad company is quoted as saying: "We expect to run a few cars in Cedar avenue the latter part of this month and in Euclid avenue about a week later. The work is rapidly advancing. One engine and four dynamos are in the power house on Cedar avenue ready for work. On Euclid avenue the ground work on one track is completed out as far as the cemetery, and we are now working on the other. The poles are set in Cedar avenue from the station out to Oakdale street. Next Tuesday night they will all be set. When completed the system will not be ungainly or noticeable. A pole will be set every 120 feet on both sides of the road opposite each other and connected by guy wires. The trolley wire that runs directly over the car is 18 feet in the air and is only about an eighth of an inch in diameter. Rising from the deck of the car will be a pole terminating with a wheel, which will run along the trolley wire. On one side of the road a feed wire will run along the poles, and from this at distances of 500 or 1,000 feet apart feed wires will run from the main feed wire to the trolley wire, so that an accident to the trolley wire will render the system inoperative only between the little feed wires. Our system is similar to the one in Akron, only better. At night the cars will be illuminated with incandescent lights. The whole affair is very nice, but costs money; $150,000 is a very small estimate of what this will cost."

The stockholders of the Brooklyn street Railroad company of Cleveland have made contracts with the Thomson-Houston company for placing their system of electric street car motors in operation upon the South Side street railway and with the John Stevenson company for a number of new cars adapted to the system, were formally closed. If the working of the new motors on the South Side road proves satisfactory, the entire Brooklyn system will be supplied with them. Work has already begun on the South Side line and the electric motors will be ready for use by the time the new Central viaduct is completed.

The Julien Electric company is running three cars on Fourth and Madison avenues, New York. Until recently, the batteries were changed after each round trip of twelve miles. Now they are changed after the second round trip, or twenty four miles. Even then, the battery requires but about three hours charge, before it is put on the car again. The company hopes very soon to make three round trips, or thirty-six miles, with one charge. If it can accomplish this, there will be required but one charge of battery a day, thus making a great saving of time and labor. In other words, horses will be changed but once a day. All this is due to the scientific progress the Julien company is making, more especially in the storage battery. The company has done a great deal of experimental work on the three cars now in use, and has put them to such practical tests, as to be able to settle on a standard Hereafter, the standard car of the Julien Electric Traction company will be an 18 foot body, mounted on an independent rigid truck, with a six-foot wheel base and, on Fourth avenue line, a 15 horse power motor, geared to each axle The car will carry 144 cells in six groups of 24 each. This novel grouping is for economy; for by this means, the motors will be run most of the time in series, instead of all together in parallel, as at present. It is a remarkable fact that none of the Julien cars have yet broken down or become disabled since they were put in service; but have always got back to the station without any external aid.

The Omaha *Bee* of November 11th, has this reference to the Council Bluffs and Omaha electric road, constructed by the Thomson-Houston company. Yesterday afternoon a motor train was run over the new bridge—the first one to cross. The party consisted of members of the bridge company, headed by Manager Evans and accompanied by a number of prominent citizens and representatives of the press. There are many little details of construction which are not complete and perfectly adjusted, but the motor worked like a charm. Its speed was regulated easily, the starts and stops were quick and smooth, and all seemed delighted It is apparent that when everything is complete and in working order the motor will win a popularity bordering on enthusiasm. The stop in Omaha was brief. The party were there joined by Charles L. Pullman, the manufacturer of the elegant cars used on the line, Theo. P. Bailey, of Chicago, the general agent of the Thomson-Houston electric company, whose system is used on the motor line, Ben Smith, W. C Morse, Frank Murphy, J. H Millard and other well-known Omaha gentlemen. The return trip was made at a rapid speed, especially along Avenue A. The date has not been decided upon for the adoption of a schedule with regular trips. Mr. Pullman and Mr. Bailey had a long consultation with the officers of the company yesterday. The assurances are given that the finishing touches will be put on as rapidly as possible. The public will not have many days to wait before they can have the regular service.

THE TELEPHONE.

The direct telephone line between Atchison and Topeka Kan., has been completed.

The opening reception of the Chicago Telephone Pleasure club took place November 15th. About 200 employes of the telephone company were in attendance.

Electric light wires became crossed with the telephone exchange wires in Pittsfield, Mass., November 3d. A telephone operator heard the continuous calling, and when he raised the telephone to reply he received a shock that knocked him over the railing. A fire subsequently occurred in the telephone switch tower, which burned all the wires.

The strokes of the fire alarm early last evening and the extinguishment of the electric lights were caused by the breaking of a telephone wire on Caroline street, which fell across and interrupted the alarm and light circuits, says a paper published at Saratoga Springs, November 9th. A man was placed by the broken wire to warn people of the danger of contact.

THE TELEGRAPH.

Boston, Chicago, and Philadelphia are as near Wall street for the purposes of business as though they were but a block away, says Brayton Ives, in the *North American Review*. One hundred and ten private telegraph wires run from offices connected with the exchange to various parts of the country. Orders for the purchase and sale of stock have been sent from Chicago, executed in the exchange, and the transaction reported back to Chicago within a minute. The average time occupied in sending messages by cable to London is not much over six minutes.

Julius D. Abeles, of St. Louis, has begun a suit in the Circuit court against the Western Union Telegraph company to recover $431, an amount he alleges, that he lost by the failure of the company to deliver to him a message sent from San Francisco. It appears that he was the owner of

2,450 shares of the stock of the Black Oak Mining Smelting company, of California, for which he had been offered $1,225. He sent Mr. Rich, an expert, to California to inspect the mine and to telegraph the result of the investigation. He alleges that on May 23d, last, Rich telegraphed him from San Francisco that the outlook was unfavorable, using a cipher telegram previously agreed upon; that the telegram was never delivered to him, and when he ascertained the true condition of the property he was compelled to sell his stock for $789 75. He sues to be reimbursed for the loss.

Miscellaneous Notes.

W. H. Cole will read a paper before the St. Louis Engineers' club on "Steam plants for electrical service."

The Bloomington, Ill., Electric club held its third meeting November 11th. There was a large attendance; the subject of static electricity was discussed. "Magnetism" was assigned as the next topic. Two papers were assigned, on the subjects of atmospheric electricity and the molecular theory of static electricity.

As water power is cheap in Kearney, Neb., a company is considering the advisability of locating a storage battery station there. The company proposes, if investigation proves the practicability of the plan, to equip a plant in the city, to be employed solely in charging batteries. The batteries would be shipped to points where they could be utilized for light or power.

The Chicago & Alton railroad has adopted an electric signal to protect the rear end of trains on Cayuga grade, at which point they descend with great speed, says a Bloomington, Ill., paper. The device is one patented by the Pennsylvania Steel company. It consists of a bar running along the side of the rail, being raised about three-eighths of an inch above the rail, and the weight of an engine or cars running over it depresses the bar, which when relaxed, starts a small dynamo encased in a small iron box near the track, connected with the telegraph line. The circuit being a metallic one, no ground connection is used. Thus a train leaving Odell depresses the slightly raised bar which starts the dynamo, whose current raises a semaphore arm, displaying danger, which continues in this position until the train has passed the station at Cayuga, when the Odell arm is lowered or released, and a similar arm is displayed at Cayuga until released at Pontiac, so on at each succeeding station. These signals are very costly, and have had a thorough test in the east, and it is the intention of the C. & A. railway to equip all dangerous places with it where trains are most exposed. This, in addition to flagmen, insures absolute safety.

Business Mention.

The National Electric company of Eau Claire, Wis., through Walter K. Freeman, has sold a 15 arc light plant to Lodge, Davis & Co. of Cincinnati, O.

The Cobb Vulcanite Wire company of Wilmington, Del., reports a large business. It is finding it necessary to increase its capacity for manufacturing and is consequently about to enlarge its works to three times their present size. The reports coming from those using the wire of the company show that it is one of the best.

The Electrical Supply company of Chicago is agent for the Tanner telephone attachment. This instrument is intended for use on transmitters. It is of trumpet shape and has a sound chamber provided with a series of perforations which prevent air compression and rattling of the transmitter while in use. It is made of the finest brass, heavily plated with nickel, and is decidedly ornamental.

The Globe Carbon company has come rapidly to the front, owing to the excellence of the goods which it furnishes. The demand for Globe carbons has become so large that the company will put on a night force, and thus increase their capacity to 1,000,000 carbons a month. This is remarkable when the short time the company has been doing business is considered. The Cincinnati exposition was admirably lighted with Globe carbons.

The Julien Electric company is making largely increased sales of its storage battery. From November 1st to the 16th, eleven (11) installations were sold, amounting in all to 1,540 accumulators—the largest sales probably ever made here or abroad in the same length of time, by any company engaged in storage battery business. The company has now a thoroughly equipped installation department. It has reduced the storage battery industry to the same practical level as the business of direct lighting.

The Garlock Packing company, whose factories are at Palmyra, N. Y., and Rome, Ga., has just enlarged its Palmyra plant. This enterprising firm has succeeded in working up a large business during a comparatively short space of time in Garlock's ring packings. Voluntary testimonials are received every day of this tenor: "Would not do without it for four times its cost." The facilities of this company for quickness and carefulness in executing orders cannot be surpassed. The packings can be obtained directly of the company or of their agents.

The Hawkeye Electric Manufacturing company of Oskaloosa, Ia., W. A. Durfee, president, announces that it has sold its entire business and good will to the Hawkeye Electric Manufacturing company of Davenport, Ia. The entire plant at Oskaloosa will be removed to Davenport, where the extensive shops lately occupied by the Donahue Foundry & Machine works, are to be used. M. L. Marks is president of the new company; E. P. Lynch, vice-president; Walter Chambers, secretary and treasurer; William Bowen, general manager, and Frank Thone, electrician. The articles of incorporation fix the capital stock at $51,000, which may be increased to $250,000.

The Southwestern Electrical Supply company of Kansas City, Mo., has issued the following circular letter: "We desire to announce to our friends and patrons that in the future we shall confine our business in carbons to our new acquisition, the Comet carbon. We have secured control of these carbons for all surrounding states, and future work in this line will be toward the introduction and sale of these goods. By a new process recently discovered, we are able to claim for our carbons that in brilliancy of light they are unequaled by those made under the old process and the waving appearance of the light so plainly seen reflected on the globe, is entirely overcome. We want every manager of an electric lighting plant to give these new carbons consideration, and in order to introduce them we will quote for a limited time: 7-16 x 12 for any system, $12.50 per 1,000; 1-2 x 12 for any system, $13 per 1,000. Orders will be promptly filled from stock and satisfaction guaranteed."

In a long article descriptive of the extensive plant being erected by the Narragansett Electric Lighting company, at Providence, R. I., the *Journal* of that city says of the steam plant: "In the engine equipment a radical departure from the present motive power will be made as the result of a thorough study of the economy of the several types of engines, and while the conclusions reached are in advance of the general practice in this country, they are in full accord with the latest English research. The new engines will be triple expansion, of 1,000 and 500 horse power, steam-jacketed cylinders and receivers, and surface condensers. The Reynolds engines, built by E. P. Allis & Co. of Milwaukee, have been selected. Mr. Reynolds has probably designed more compound engines than any other builder in this country, and has succeeded in obtaining results which enable him to guarantee an economy in excess of that offered by any competitor. An ordinary high-pressure engine of the Corliss type gives an indicated horse power for every 26 pounds of water per hour; if made condensing the consumption per indicated horse power is reduced to 19 or 20 pounds, and if compounded, to about 17 pounds. The plant in use at the Aborn street station requires over 50 per cent. more water than the largest amount named above per indicated horse power. Mr. Reynolds has introduced triple and quadruple expansion stationary engines with great success, the quadruple expansion engine at Warren, the only one in this country, showing a horse power on less than 14 pounds of water. For the engines of the Narragansett Mr. Reynolds has guaranteed that they shall develop an indicated horse power on 12½ pounds of water per hour, which is stated to be the lowest guarantee on which an engine was ever built. This guarantee was based on a boiler pressure of 125 pounds to the square inch, and the increased pressure of 160 pounds will favor the economic performance. The engines will have cylinders 13, 18 and 30 inches in diameter and 48 inches stroke, a 16-feet fly-wheel, and will run 100 turns per minute. The high pressure and intermediate cylinders will be arranged tandem, and the low pressure cylinder will be set parallel with them, and will act upon a separate crank. If the reader will kindly imagine four 1,000 horse power and one 500 horse power triple expansion engines, a better idea of the engine room will be obtained. The condensing apparatus, circulating pump and feed-water pump are operated by an independent engine. An original feature of interest is that the feed-water pump will be automatically operated, its movement being governed by the height of the water in the boiler. The changes of level there operate to shift a link motion, by which the stroke of the pump is lengthened, shortened or stopped."

Electrical Patents.

Issued November 13, 1888.

392,604. Combined Fire Alarm and Telephone-Telegraph. George C. Hale, Albert Barrett and Joseph Zetner, Kansas City, Mo.

The 8th claim follows: "In a combined system of fire alarm and telephone-telegraph, the combination, with an exchange circuit and an outlying telephone apparatus, of an alarm circuit having a separate telephone apparatus included therein, a manual switch for interposing the outlying telephone apparatus in the alarm circuit, and registering mechanism operated by the switch for recording each call from the outlying station to headquarters."

392,633. Electric Lamp Switch. Charles G. Perkins, Hartford, Conn.

392,641. Auxiliary Fire Alarm Box. Eason L. Slocum, Lincoln, R. I.

395,660. Insulation of Cores of Dynamo Electric Machines. Benson Bidwell, Chicago, Ill. The claims are appended:

"1. In a dynamo electric machine or motor, a field magnet core covered with sheets or spools of thin metal, said metallic sheets or spools being covered with porcelain, glass or other vitreous material.

"2. In a dynamo electric machine or motor, an armature core covered with sheets of thin metal, said metal sheets being covered with porcelain, glass, or other vitreous material."

392,664. Conduit for Electric Railways. Henry A. Chase, Stoneham, Mass. The first claim follows:

"1. The combination, with a conduit having a longitudinal slot in its top at one side thereof and a single division wall extending from said slot to the base of said conduit to form chambers, the said wall being provided at intervals with openings to afford communication between said chambers, of an electric conductor located in one chamber."

392,665. Electric Gas-Lighter. Henry A. Cleverly, Philadelphia, Pa.

392,666. Incandescent Lamp Socket. Theophilus Coad, Forest Gate, County of Essex, England.

392,675. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The car is provided with an electric motor, electric lamps, and other translating devices, which are supplied with electricity from the line current or from batteries on the car, or from both combined. The first and last claims are:

"1. The combination of a car body having contacts and removable batteries, also having corresponding contacts, with exposed contact surfaces adapted to rest upon the contacts in the car body and bring the weight of the batteries largely upon said contacts to insure good electrical connection.

"19. The combination of a series of secondary battery cells, a charging circuit, an electro-magnet in said charging circuit, a signal circuit, an automatic circuit closer for said signal circuit, a signal in said signal circuit, an electro-magnet in the charging circuit to actuate said circuit closer to hold it open while charging the battery, an electric motor, a circuit including the battery and motor, a reversing switch to reverse the current in the motor, and a circuit breaking switch to cut the battery current out from the motor."

392,698. Coin-Controlled Electrical Weighing Scale. William R. Smith, Bandera, Tex., and Albert L. Washburn, New York, N. Y.

392,701. Electric Machine for Lighting and Extinguishing Gas. George E. Thaxter, Boston, Mass.

392,724. Electrical Circuit and Apparatus Guard. Isaiah A. Farnham, Malden, Mass.

The invention consists, essentially, in applying to the electro-magnet of any electrical instrument an extra armature responding only to the passage of an abnormally strong current through the magnet coils and controlling a normally open shunt circuit arranged around said magnet or around any number of instruments, or adapted to maintain normally the integrity of the main circuit, but to cause the same to be impaired upon the passage through the magnet coils of an unduly strong current. The first claim is given:

"1. The combination, substantially as hereinbefore described, of an electric circuit, an electric instrument included therein, a normally open shunt of said circuit round the magnet of said instrument, a circuit closer controlling the terminals of said shunt circuit, an auxiliary armature controlled by an electro-magnet included in the main circuit and normally interposed in the path of said circuit closer, and thereby preventing its operation, but releasing the same when attracted, and a retarding device to prevent the circuit closer from acting when released by a momentary and non-continuous attraction of said armature."

392,736. Electrical Apparatus for the Prevention of Incrustation. Maximilian Koytra, Cardiff, County of Glamorgan, England.

The invention relates to a method of using an apparatus for applying electrical currents to the shell of a steam boiler for the purpose of preventing corrosion and the deposition of scale; and it consists in the combination with the boiler shell of a suitable conductor inside the boiler, any suitable source of electricity, and an alternating apparatus by the operation of which the current between the said conductor and the boiler shall flow first in one direction and then in the other. In carrying the invention into practical effect, use is made of a rod or plate of iron, copper or other suitable conductor, supported or suspended at a proper height within the boiler. This rod or plate is partly covered with a coating of zinc or other suitable conductor. The connection of this rod or plate, which acts as an electrode, is of such a kind that it shall be permanently and effectually insulated from the boiler shell. The boiler shell and the electrode are respectively connected to the alternating apparatus, and this on its part is connected to the poles of the battery.

392,757. Overhead Conductor for Electric Railways. Elias E. Ries, Baltimore, Md.

Claim 3 reads: "In an electric railway, the combination of a charged line conductor extending parallel with and between the inner rails of a double track and having pairs of opposed contact surfaces, with a contact truck for each track deriving current from each pair of contact surfaces of the same line conductor, an electric locomotive upon each track, and a flexible conductor from each contact truck to its respective locomotive."

392,763. Mounting for Diaphragms for Acoustic Instruments. Charles S. Tainter, Washington, D. C.

The diaphragm is clamped between two thin metal washers, grooved or struck up, so as to present a bearing ledge for contact with the diaphragm.

The first claim is as follows: "The combination, with a vibratory diaphragm, of a grooved or struck-up metal washer in contact with said diaphragm at its edge, and supporting and clamping devices."

392,765. Dynamo Electric Machine. Elihu Thomson, Lynn, Mass.

The invention relates to the manner of applying and connecting the electric conductor that is wound upon the armature of a dynamo electric machine or motor, and in which the electric currents are generated, or in which the flow of an electric current produces movement of the machine. The invention consists, essentially, in making two or more joints or connections to each turn or length of armature conductor, the said joints or connections being carried, respectively, to different segments of the commutator. The effect is to secure a machine in which the number of turns of wire on the armature is less than the number of segments in the commutator. Another object of the invention is to avoid the local currents developed in armature conductors of large diameter or section, which currents heat the conductors, and cause great waste of power.

The first and second claims are given: "1. In a dynamo electric generator or motor, the combination, with each single turn or length of armature conductor, of two or more commutator leading wires.

"2. In a dynamo electric machine or motor, the combination, with an armature having a given number of

turns or lengths of conductor, of a commutator having a number of segments that is a multiple of the number of conductor turns or lengths."

392,766. Signaling Apparatus. Wesley Trafford, New York, N. Y.

392,772. Electrical Railway. Orren Allen, Denver, Col.

The first claim follows: "An improved system of electrical railroading embodying a vehicle, a motor carried by and propelling the vehicle, a main circuit, a conduit, contact-arms located at intervals therein for operating circuit-shunting mechanisms, circuit-shunting mechanisms contained in separate and closed boxes and included in the main circuit and operating to break the main circuit and shunt the current through the motor, and a mechanical connection from a set of contact-arms to a shunting mechanism."

392,775. Electric Circuit. John A. Barrett, Brooklyn, N. Y.

The invention relates to the neutralization and elimination of induction between parallel electric circuits, and is especially adapted for use in telephony.

Claim 2 is as follows: "A group of parallel metallic circuits supported on poles, each two circuits immediately adjacent in any direction—horizontally, vertically or diagonally—being made inductively neutral to each other by causing the direct and return wires of one of them to cross or exchange places in such manner that the average distance of each wire of said crossed circuit from the two wires of the other shall be the same."

392,855. Automatic Governor for Dynamos. Edward B. Coburn, Walpole, Mass.

392,863. Electric Railway. Benjamin Heywood, New York, N. Y.

The invention relates to that class of electric railways in which the car is driven by an electric motor carried thereon, and receiving electricity through a conductor in, or contiguous to, the track.

The third claim reads: "The combination, with the hollow rail, the insulated conductor therein, the flexible water tight cover, which serves to inclose the conductor within the cavity of the rail, and the metallic contact pieces attached to said cover of the metallic brush carried by the car, and the elastic insulating sheath surrounding the face of the said brush, and serving to wipe water from said cover and contact pieces."

392,890 Regulation of Electric Motors. William Stanley, jr., Great Barrington, Mass.

The two claims read: "The improvement in the method of regulating the speed of electric motors, which consists in automatically varying the electromagnetic effect of a demagnetizing current upon the field of the motor by introducing variations of resistance in said circuit coincidently with, and proportionately to, variations in the mechanical duty of the motor.

"The hereinbefore described method of governing electromotors, which consists in automatically varying the current traversing a demagnetizing circuit applied to the field magnet of the motor by varying the resistance of said circuit coincidently with, and proportionately to, variations in the mechanical duty of the motor."

392,914. Telegraphy. Stephen D. Field, Stockbridge, Mass.

The second claim is: "A telegraph relay comprising two or more nested coils suspended in, and inductively energized by, a common field of force, and provided with levers and contact points for the local circuits."

392,930. Method of Synchronizing Electric Motors. Francis J. Patten, New York, N. Y.

The invention consists in a method of establishing synchronous motion of the rotary parts of two or more electric motors by providing each of the motors with independent field magnet and armature circuits, and causing simultaneously in one of these independent circuits of each motor reversals of current, and in causing a direct current to flow through the other independent circuit of each of the motors.

392,951. Automatic Fire Extinguisher and Alarm. Isaac T. Dyer, Chicago, Ill.

392,967. Synchronizing System for Electric Motors. Francis J. Patten, Bath, Me.

The purpose of the invention is to cause two or more electric motors of any size and power, and located at different distant points, to revolve in unison or at a common rate of speed for all; also to follow any change of speed to which a governing or controlling machine may be subject, and therefore produce uniform motion of all at either a constant or a variable speed. In this system the motors are all independent of each other, being each supplied by a separate local source of energy.

392,970. Annunciator. Foster Ritchie, Chicago, Ill.

The first claim reads: "In an annunciator the combination of a magnet and index hand, the spindle therefor having a common axis with the magnet, a gravitating notched lever fixed upon said spindle, a flexible but otherwise fixed armature, and a pin secured to said armature, said pin engaging the notched lever when the armature is demagnetized and disengaged from said lever when the armature is magnetized."

392,971. Electric Railway. Ira Robbins, Camden, N. J.

The first claim is given: "A conduit for electric railways having a conductor inclosed in a channel in its upper surface, and to one side of the center thereof, said conduit being embedded in wooden blocks."

392,826. Automatic Switch for Secondary Batteries. John S. Sellon, Hatton Gardens, County of Middlesex, England.

The invention is designed to preserve a uniform electromotive force in the current furnished by a storage battery. It consists of an electro-magnetic or other suitably constructed switch, which can be actuated by the outgoing current when such current falls below a given electromotive force, so as to cause the magnet or magnets to switch in one or more accumulators from time to time as may be required for the purpose of maintaining a constant or practically constant electromotive force.

The first claim follows: "The combination of two or more cells of secondary battery, a switch consisting of two or more fixed contact points connected at different points in the said battery, respectively, and a movable contact operated by an electro-magnet in the working circuit, with a second electro magnet operated by variations in the electromotive force to make and break a short circuit around the first-named magnet."

392,832. Individual Signaling Apparatus. Charles N. Talbot, New York, N. Y.

The invention is intended to be used in connection with police signaling systems, as a means whereby the attention of any policeman can be attracted from the police station, so that he may know that the station desires to communicate with him, and may proceed to his telephone box and call up the station.

The first claim is given: "In individual signaling apparatus, the combination, with the signaling devices, each having a magnet, a signal operating arm controlled by said magnet, and an adjustable stop for said arm, all said stops being differently situated relative to the respective arms, and a magnet adjusting said stop by a step-by-step movement, of the transmitting break wheel in the circuit of said adjusting magnets, having an adjustable automatic circuit-controller affecting the circuit of the signal controlling magnets."

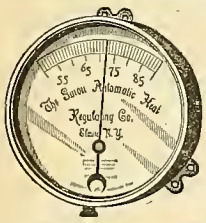
392,836. Carbon Battery. John B. Wallace, Ansonia, Conn.

392,838. Message and Time Recorder. John C. Wilson, Boston, Mass.

The invention consists in the combination, with a message recorder, comprising registering mechanism and paper-moving mechanism, of a time stamp consisting of a dial and indicating hands or pointers, and means for actuating the hand stamp automatically to print the time upon the strip.

392,843, Telephone Support. Sigmund Bergmann, New York.

The claim follows: "The combination, with a telephone containing a body of mobile material, of a vertically swinging arm upon which said telephone is pivoted above the center of gravity."



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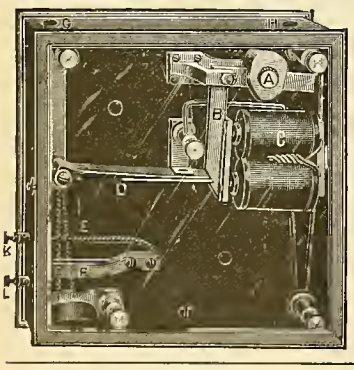

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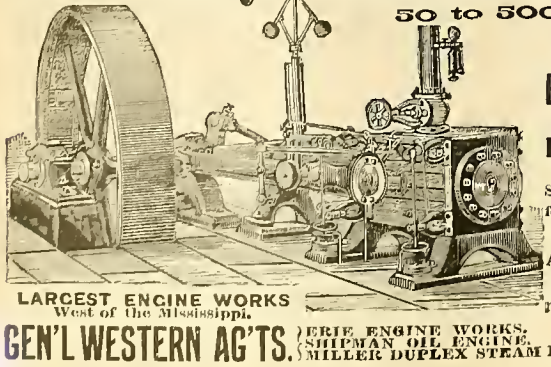

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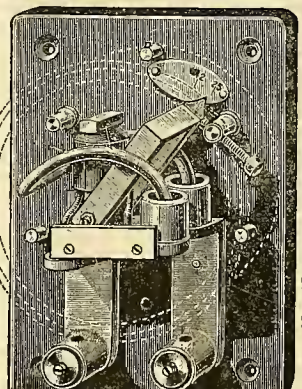

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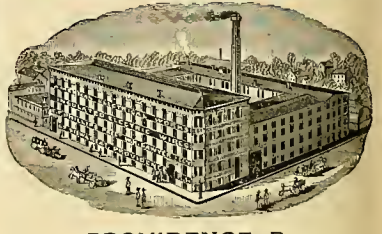

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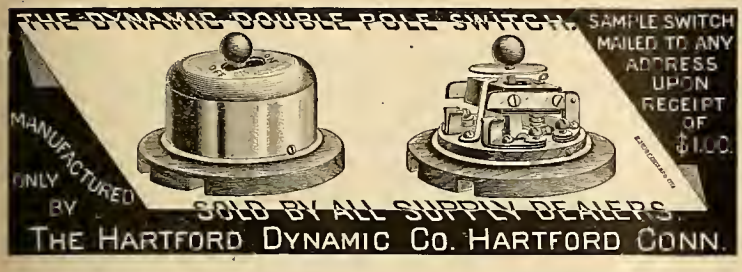

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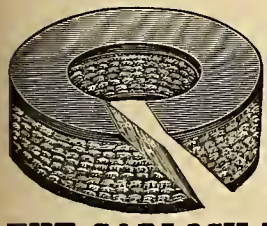

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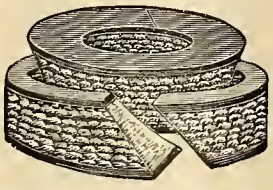

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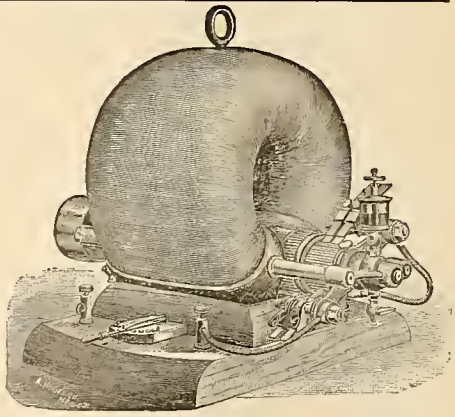

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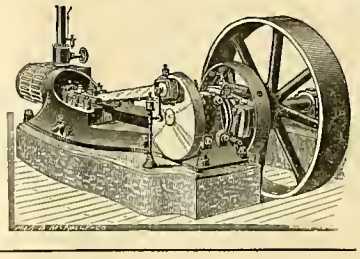

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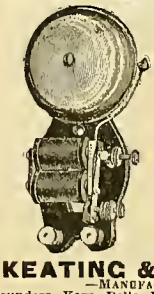

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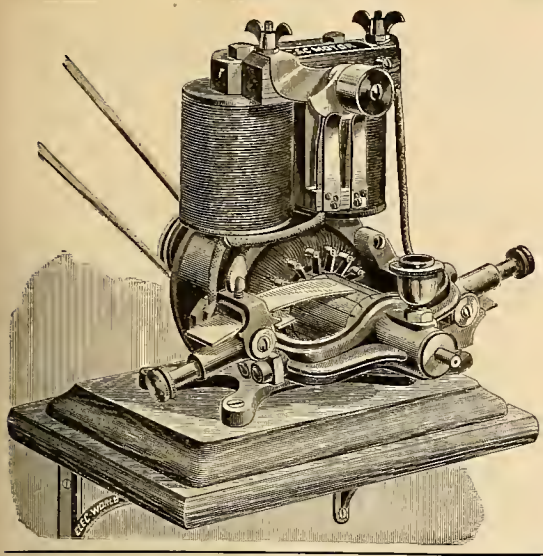

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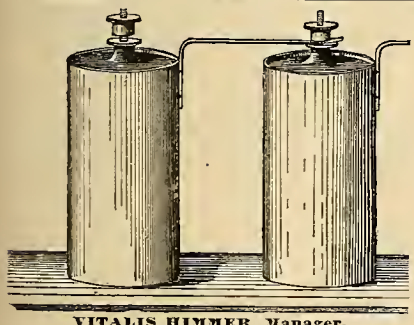

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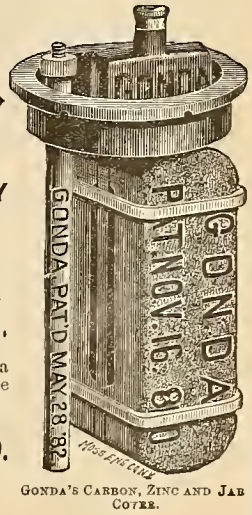

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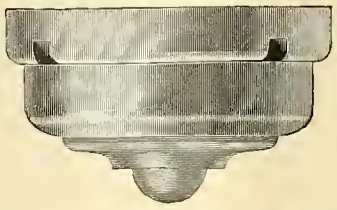

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Gentlemen: — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good timekeeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.

Sure protection from all Electrical and Magnetic disturbances.
Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
Prof. Phs. Dept., Cornell University.

The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and in operative on account of their susceptibility to the all-pervading magnetic influence.

AMERICAN WATCH CO.,
Waltham, Mass.

GILES BROS. & CO. 103 State Street, CHICAGO.

THE LIST OF SALES OF THE

Westinghouse Engines: Compound, Standard and Junior,

FOR THE MONTH OF OCTOBER, 1888,

Is too long to publish *in extenso* as an Advertisement. Orders were received on eighteen working days, the five heaviest days yielding respectively, 16, 11, 10, 8, and 7 ENGINES EACH.

TOTAL, 86 ENGINES, AGGREGATING 3310 H. P.

Sales for August, September and October were over 200 ENGINES of all types, aggregating nearly *10,000 HORSE POWER*. Note in connection with the above exhibit, that our current advertising expenses for 1888 are about one-half that of any preceding year.

WHY IS IT?

The Woodbury

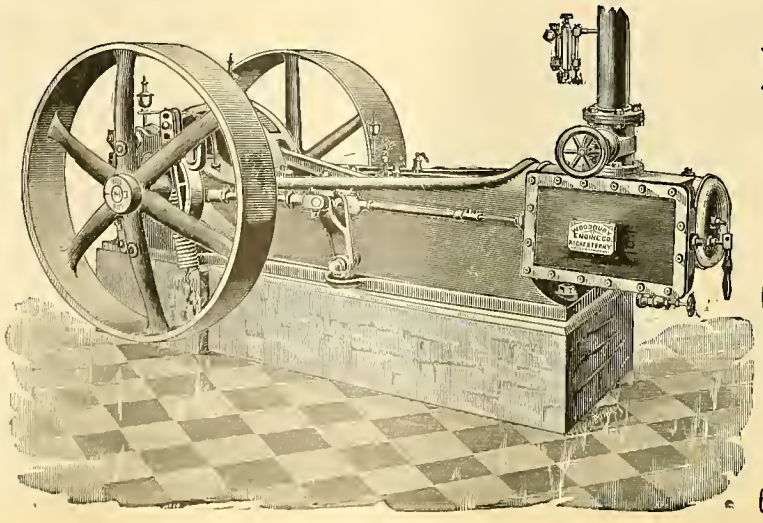
AUTOMATIC

Cut-Off High Speed

ENGINE.

MANUFACTURED BY

WOODBURY ENGINE COMPANY.



ALSO BUILDERS OF

PLAIN SLIDE VALVE

—AND—

Double Valve Medium Speed

AUTOMATIC

Cut-Off Engines

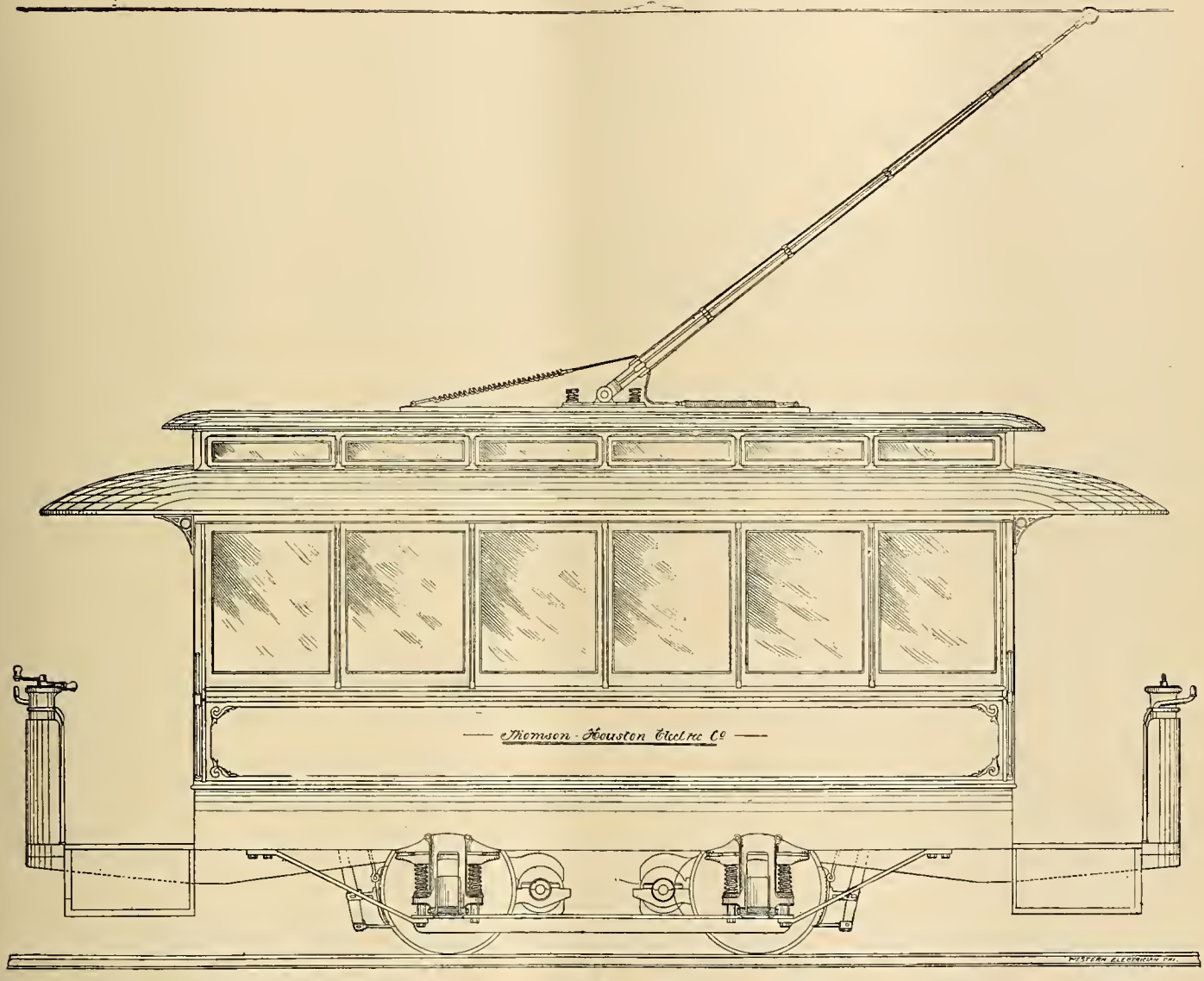
—AND—

TUBULAR BOILERS.

Address the Manufacturers at

652 Mill Street, ROCHESTER, N. Y.

The Thomson-Houston Electric Railway System.



Nineteen Roads in Daily Operation Under the Thomson-Houston Patents.

ALL MATERIAL IS NOW MANUFACTURED AT THE **FACTORY** *AT* **LYNN,** *MASS., THE LARGEST AND BEST EQUIPPED ELECTRIC FACTORY IN THE WORLD.*

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Thomson-Houston patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

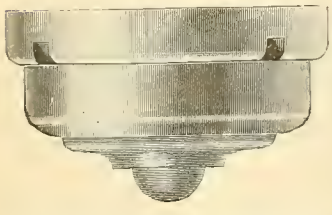
MOTORS & ELECTRICAL EQUIPMENTS FURNISHED FOR MINING & OTHER SPECIAL WORK.

For Full Information and Estimates Address the

THOMSON-HOUSTON ELECTRIC COMPANY,

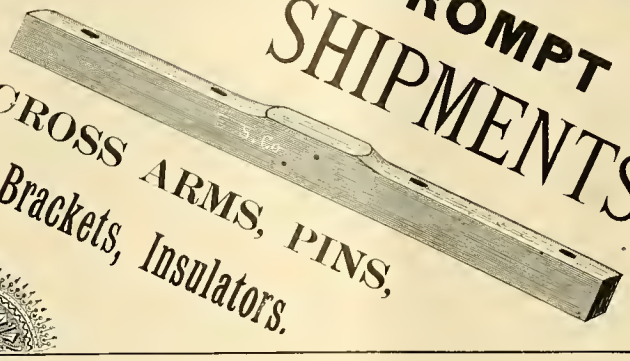
620 ATLANTIC AVE., BOSTON, MASS. 148 MICHIGAN AVE., CHICAGO, ILL.

The Stoddard Combined Rosette AND CUT-OUT.



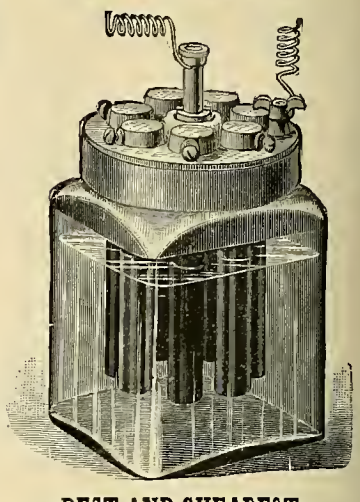
The Rosette and Cord entirely removable for replacing Fuses.

PROMPT SHIPMENTS.



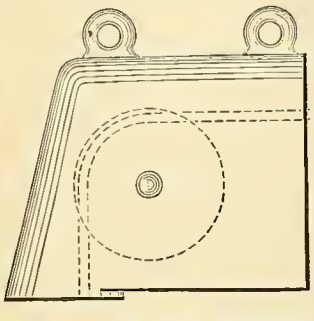
CROSS ARMS, PINS, Brackets, Insulators.

The Diamond Carbon Battery.



BEST AND CHEAPEST.

SLEET PROOF PULLEY.



SLEET STORMS ARE COMING.

MAGNET WIRE.

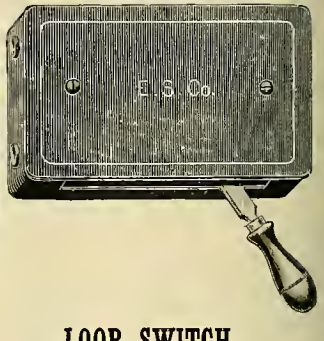
CONDUCTIVITY OF COPPER AND

Quality of Insulation Unsurpassed.

PROMPT SHIPMENTS.

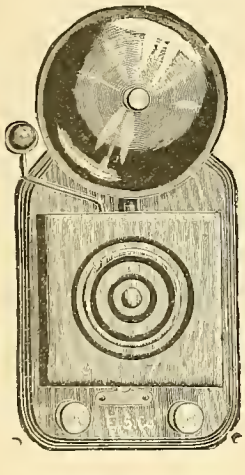
Write for Quotations.

STYLE NO. 810.



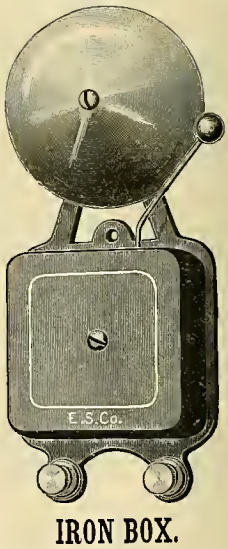
LOOP SWITCH
For Outside Arc Use.

ORNAMENTAL AND USEFUL.



HANDSOME WOOD BOX.

STYLE NO. 610.



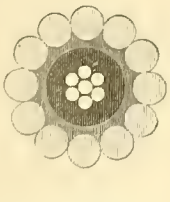
IRON BOX.

Electric Lighting Companies

ARE INVITED TO EXAMINE OUR CATALOGUES AND PRICES.

Correspondence Invited.

☞ We aim to satisfy our customers, and shall adjust our sight if we miss the mark. Let us know.



KERITE ARMORED CABLE.

Write for Quotations on

Bells, Batteries, Annunciators,

WOOD PUSH BUTTONS,

BRONZE PUSH BUTTONS,

ANNUNCIATOR WIRE, ETC., ETC.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH STREET,

CHICAGO.

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P. H. ALEXANDER, General Agent.

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C. H. BARNEY, Auditor.
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SAWYER-MAN ELECTRIC CO.

510 to 534 WEST 23d STREET,

NEW YORK,

MANUFACTURERS OF THE

CELEBRATED

SAWYER-MAN INCANDESCENT

ELECTRIC LAMP.

HIGH EFFICIENCY. ✣ LONG LIFE. ✣ NO BLACKENING.

LAMPS MADE TO FIT SOCKETS OF ALL LEADING MANUFACTURES.

PRICES GREATLY REDUCED.

WRITE FOR PARTICULARS.

FORT WAYNE JENNEY ELECTRIC LIGHT COMPANY,

Fort Wayne, Indiana.

Manufacturers of the

SLATTERY INDUCTION SYSTEM

— OF —

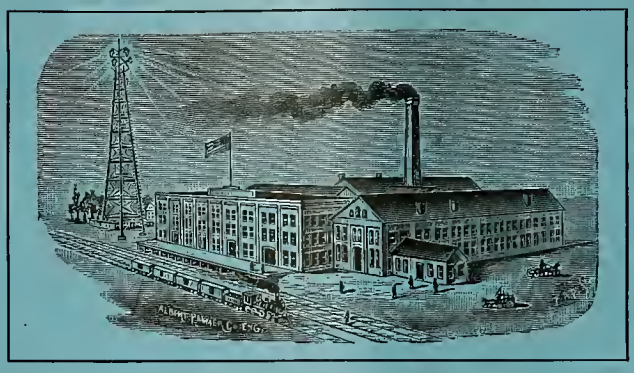
INCANDESCENT LIGHTING,

— AND THE —

JENNEY SYSTEM

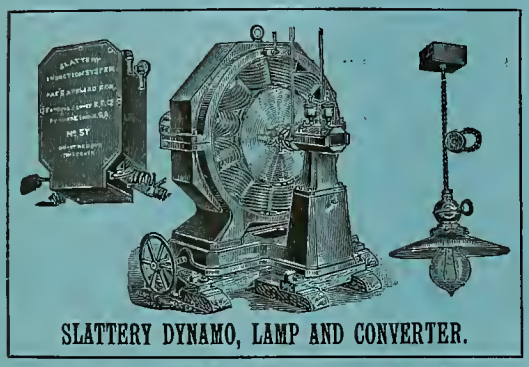
— OF —

ARC LIGHTING.



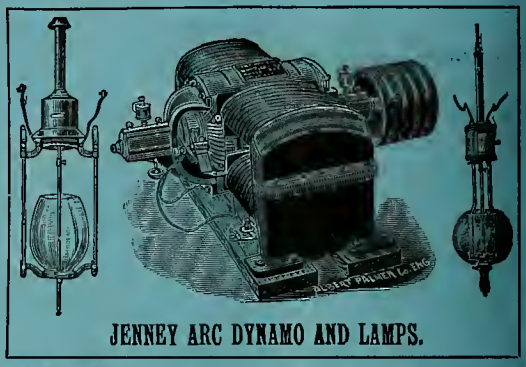
The Most Carefully Worked-out and Complete Alternating System of Electric Lighting in Existence.

Armatures and Converters Guaranteed. 12--16 Candle Power Lamps to the Mechanical Horse Power Guaranteed.



SLATTERY DYNAMO, LAMP AND CONVERTER.

CORRESPONDENCE SOLICITED.



JENNEY ARC DYNAMO AND LAMPS.

MAIN OFFICE AND WORKS.
FORT WAYNE, IND.

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W. J. BUCKLEY, Manager.

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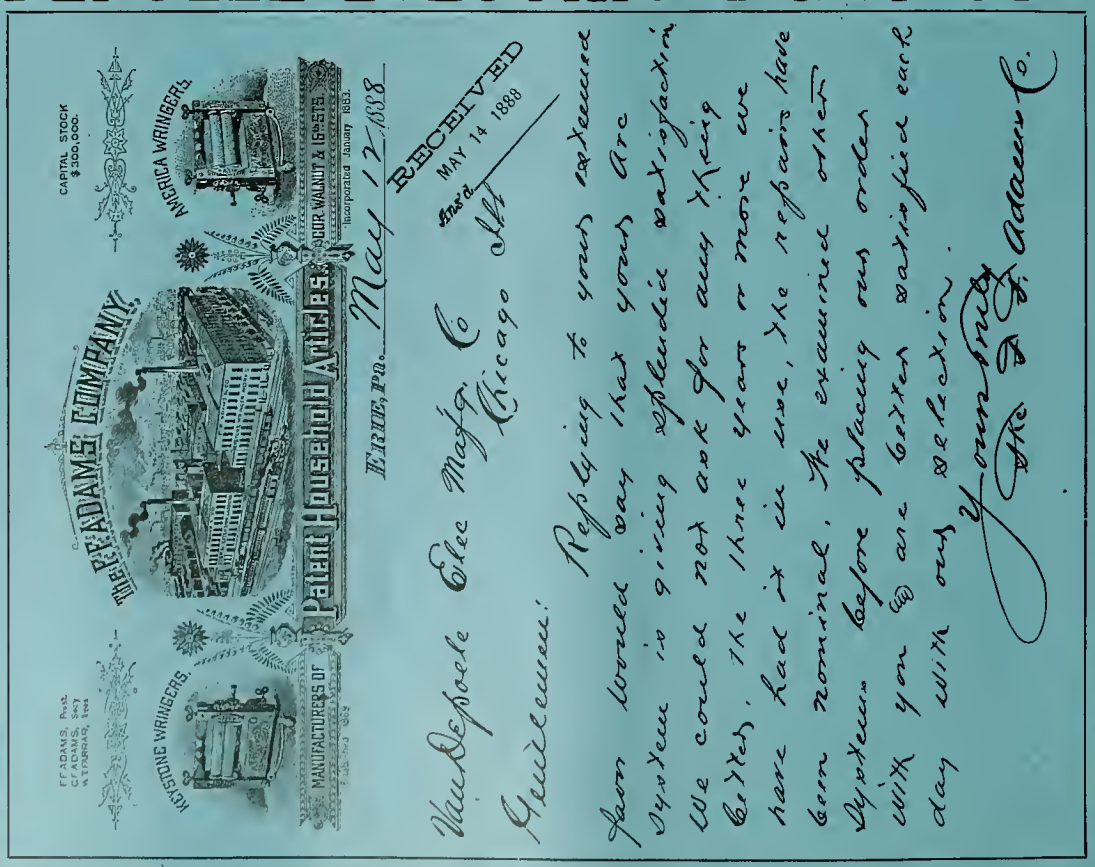
CITY OF MEXICO OFFICE. F. Adams, Successor.

VAN DEPOELE ELECTRIC LIGHT SYSTEM.



Manufactured and for Sale only by **VAN DEPOELE ELECTRIC MANUFACTURING CO.,** 15 17, 19 & 21 NORTH CLINTON ST., **CHICAGO, ILL.**

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. III. CHICAGO, DECEMBER 1, 1888. No. 22.

PHŒNIX GLASS COMPANY.

—MANUFACTURERS OF—

Electric Light Globes, Shades,

—ETC.—

SEND FOR CATALOGUE AND PRICE LIST.

729 Broadway, New York.

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Standard Underground Cable Company,

General Offices, No. 708 PENN. AVE., PITTSBURGH, PA.

Branch Offices: { New York, Telephone Building, Cortlandt Street, G. L. Wiley, Manager. Chicago, 139 East Madison Street, F. E. Degenhardt, Manager.

MANUFACTURERS OF

The Waring Anti-Induction and Bunched Cables

For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial. Light Leaded Cables for House Use Weather-proof Line Wire, Underwriters', Annunciator and Office Wire. Six years of uniform Success enable us to guarantee our Cables.

DAY'S KERITE INSULATION.

The acknowledged Standard for durable and high Insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power. Telegraph and Telephone. Railway and all other Branches of Signaling.

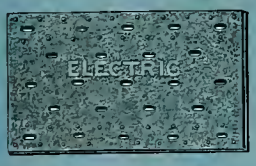
All Sizes *Lead Encased Wires.* Aerial Use. Subterranean Use. Submarine Use

Concealed Wiring in all Locations.

CLARK B. HOTCHKISS, Gen'l Mgr., - 16 Dey St., NEW YORK.

ELECTRIC PERFORATED BELTING

GUARANTEED —FOR— DYNAMOS.



PATENTED MAY 24, 1888.

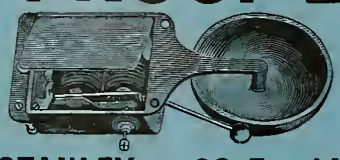
PREVENTS AIR CUSHIONS.

CHAS. A. SCHIEREN & CO., (MANUFACTURERS), 46 South Canal St., - CHICAGO, ILL.

And Manufacturers and Tanners of Oak Tanned Leather Belting, and Lace Leather.

DUST PROOF BELLS

Superior to



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HAZAZER & STANLEY, - 32 Frankfort St., N. Y.

The CALLENDER INSULATING and WATERPROOFING COMPANY,

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ELECTRIC LIGHT WIRES OF ALL SIZES A SPECIALTY.

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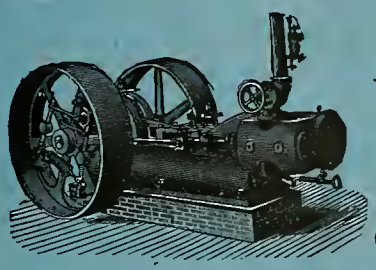
NEW YORK SAFETY STEAM POWER CO.,



Builders of High Grade Self-Contained

Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.

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Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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DANIEL W. MARMON, President. ADDISON H. NORDYKE, Vice-President.

CHARLES D. JENNEY, Electrician.

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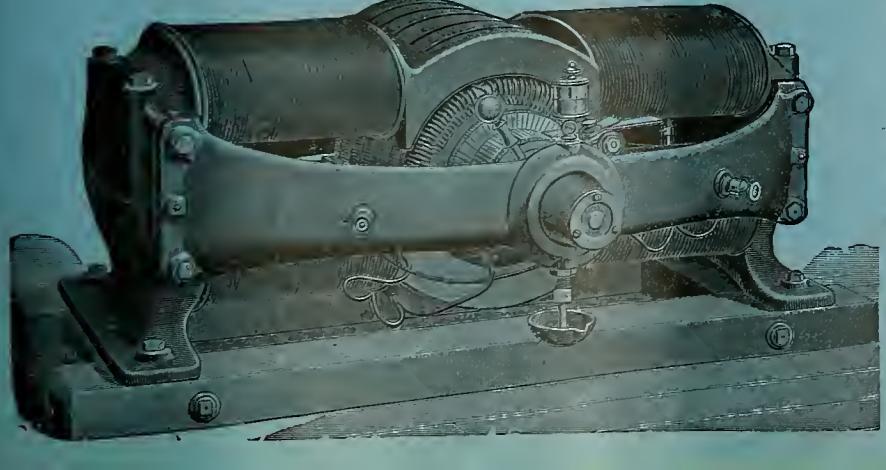
JENNEY ELECTRIC COMPANY,

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

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WESTERN OFFICE:
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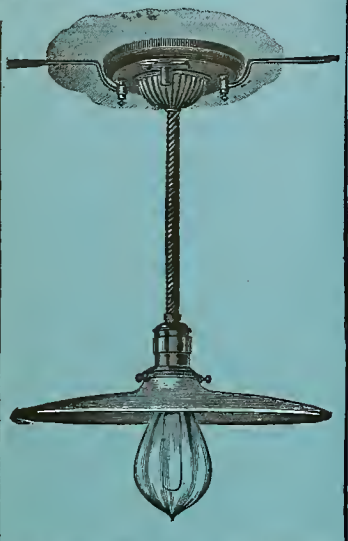
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



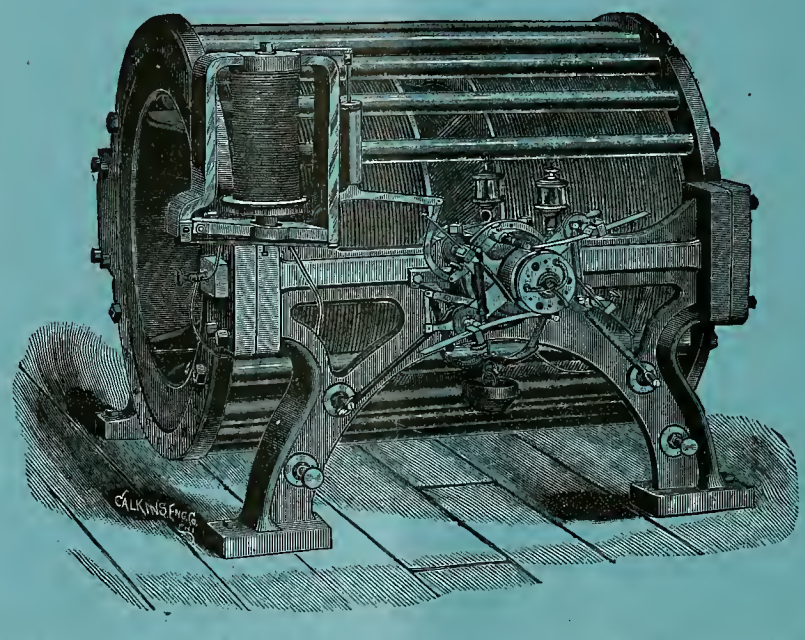
SERIES LAMPS

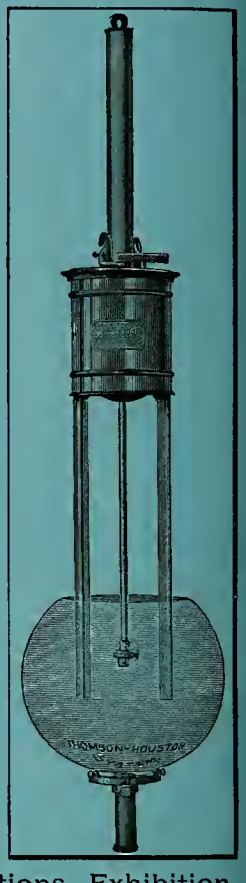
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



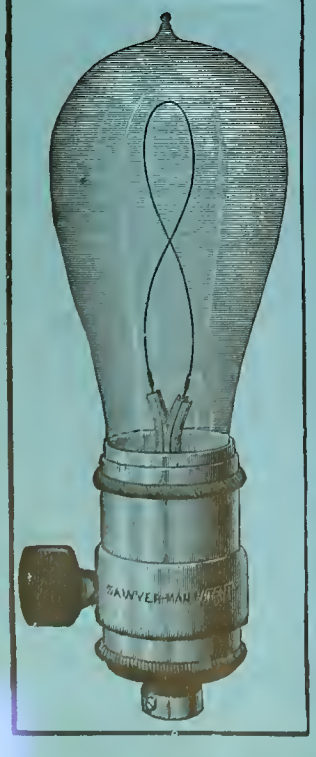


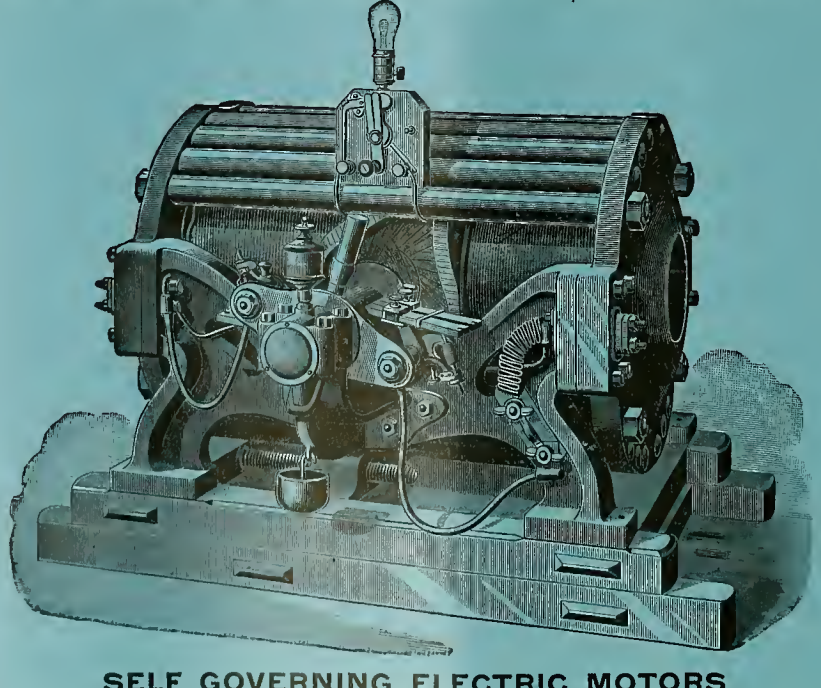
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 60,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,
16 & 18 BROAD STREET, NEW YORK.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals 11 50/100 per H. P.
Edison 348 Lamps, 54 H. P., equals 6 44/100 per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager. 219 LA SALLE ST., CHICAGO.

THE MITCHELL VANCE CO.,

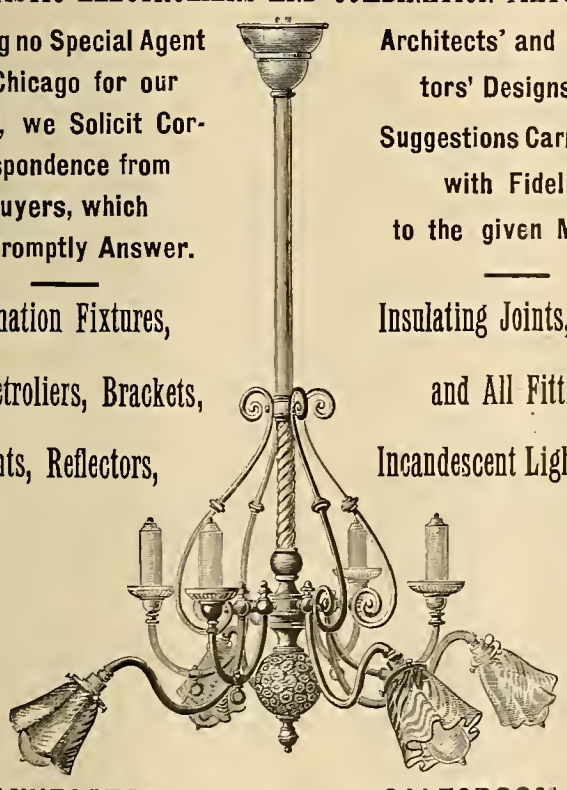
(Successors to MITCHELL, VANCE & CO.)
DESIGNERS AND MAKERS OF
ARTISTIC ELECTROLIERS AND COMBINATION FIXTURES.

Having no Special Agent in Chicago for our Goods, we Solicit Correspondence from Buyers, which we Promptly Answer.

Architects' and Decorators' Designs and Suggestions Carried Out with Fidelity to the given Motive.

Combination Fixtures,
Electroliers, Brackets,
Pendants, Reflectors,

Insulating Joints,
and All Fittings for
Incandescent Lighting.



MANUFACTORY, 24 and 25th St. and 10th Ave.,
SALESROOM, 836-38 Broadway and 13th St.,
NEW YORK CITY.

THE DAFT ELECTRIC CO.,

NEW YORK AND CHICAGO.

The only Company using Safe Currents in the operation of Street Railways.

Speed,
Endurance,
Economy.

The Daft Motors for Power Distribution are unexcelled.

Send for Circular Matter.

NEW YORK OFFICE

BOREEL BUILDING,

115 BROADWAY.

Please Mention the Western Electrician.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

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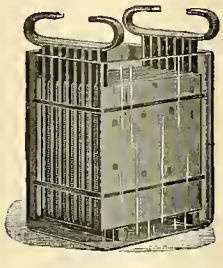

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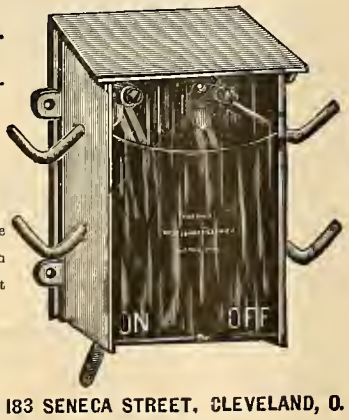

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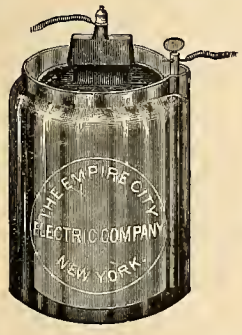

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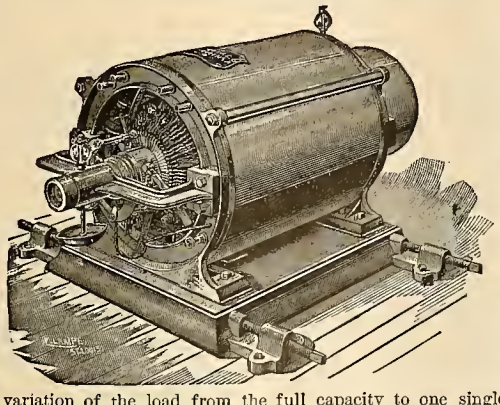

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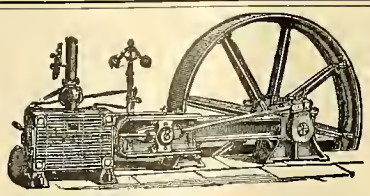

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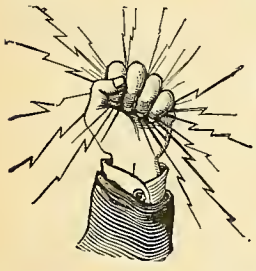

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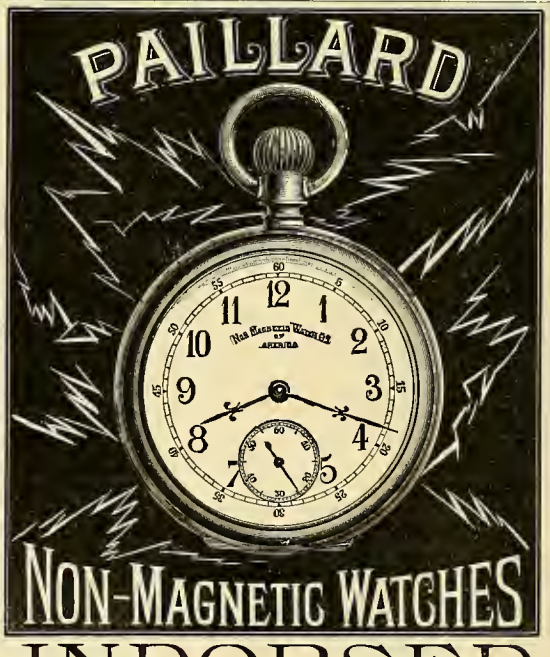

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CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, DECEMBER 1, 1888. No. 22.

A Burglar and Fire Alarm.

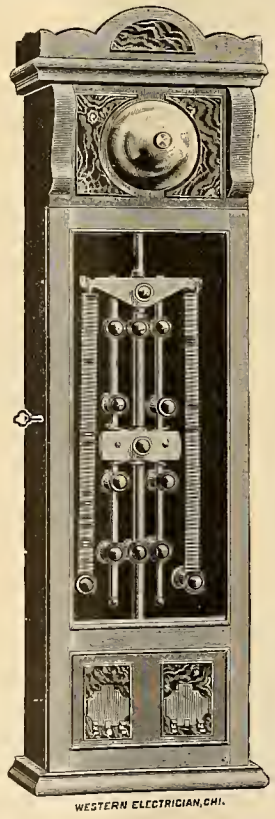
The engraving on this page illustrates a new burglar and fire alarm designed by Keating & Roxburgh of Corry, Pa. It is unlike many in use, inasmuch as it protects buildings at a distance, such as stores and offices and banks, the instrument being placed on the wall in the residence, and a line stretched to the store or office. Open circuit battery is used. If the line should be cut an alarm is sounded at the residence the same as though entrance had been made at the store and the circuit closed.

In construction the instrument is simple, consisting mainly of three brass rods supported in a case by short studs extending from the back of the case and fixed to the ends of the rods. The studs which support the outside rods are fixed rigidly to the ends of the rods; those that support the middle or longest rod fit loosely on the rod, allowing the rod to slide up and down in them. On the side rods are two check studs, one above and one below. They fit loosely upon the rods, and are held at any desired place on them by means of a set or thumb screw. The top check stud on the left hand rod is insulated from the rod by a rubber bushing. The thumb screw is also insulated. To this check stud on the back is fastened a flat spring, which engages with a strip of brass on the back of the case, behind the rod. From the strip of brass runs a wire to the coils of the left hand annunciator, to the battery, to the bell on the case, and to the rod. Attached to the middle rod, near the top, is a cross-bar, from the ends of which descend spiral springs to posts or hooks at the lower part of the case. At the center of this rod is also a shorter cross-bar, insulated on the back to prevent contact with the side rods. Across the top and bottom edge of the cross-bar is a flat spring held to the bar at the center, the outer ends being lifted toward the check studs. From the lower stud supporting this rod a wire is run to right hand annunciator coils, to the battery, and to ground. To the top end of this rod is attached the line wire, which passes up along the wall over a small pulley, and out through a hole in the wall. The insulators which support the line outdoors are wire loops, or pulleys, at the end of a wire two or three feet long, the line wire passing through them, the other end of the insulator wire being made fast to glass insulators. At the office or store the line wire passes through a hole in the wall, and is made fast to an insulator on the inside. From this connection office wire goes to one connection of each window and door springs, and to the thermostats in the ceiling. To the other connection of the window, door and thermostats, a ground wire is run. The slack is taken out of the line wire at the place where the line is made fast to the rod in the instrument; then the line is gone over and a tie wire is passed around the loops, or pulleys, making them fast to the line. It will be noted that the strain of the line draws up the rod in the instrument, and consequently the springs. The top and bottom check studs are moved close, but not so as to touch the middle cross-bar.

In operation, if entrance is made at the store the line is grounded, and circuit is made over the line, down the rod, through the left hand annunciator coils, through the battery to ground. This brings down the annunciator drop, which short-circuits the battery, including the electric bell, and causes a continuous alarm until the drop is raised. A rise in temperature at the store causes the thermostats to perform the same office. If the line is cut the springs pull the rod down, the center cross-bar makes connection with the two check studs, and forms a local circuit, including the electric bell and battery. If the line is cut and then held, a slight pull makes a cross with the upper check studs, a current is sent through right hand annunciator coils, causing the drop to fall, showing that the line has been tampered with. The drop of this annunciator causes a local and continuous ring also. It will be seen, no matter how quickly a door is opened or closed, a continuous alarm follows.

Fort Wayne Jenney Works Destroyed by Fire.

The extensive buildings which formed the manufactory of the Fort Wayne Jenney Electric Light company, at Fort Wayne, Ind., were destroyed by fire on the morning of November 23d. The origin of the fire is unknown. Various causes have been assumed to account for the conflagration, spontaneous combustion among others, but they are mere conjectures. Nothing definite can be said upon that point. The factory was situated at the junction of Broadway and the Pittsburgh, Fort Wayne & Chicago railway. The old building, containing the costly arc machinery and the engines, and the new three-story building, containing the stock room, the incandescent department and the Star Iron Tower company, were a total loss. All of the tools and the patterns, and some of the books of the company also, were destroyed. The loss on buildings, stock and machinery amounts to over $300,000, and the insurance is $148,000, divided among nearly forty different companies. Three hundred employes are temporarily thrown out of employment. The stock of the company is held for the most part by residents of Fort Wayne. It is now stated that the company will rebuild its works at once.



Combination in Wire.

The news comes from New York that a combination in wire was formed in that city on November 22d. Manufacturers of insulated wire have claimed for a considerable time that there was no money in their product at the market prices. It was then decided to form the combination. Among the firms and companies represented at the meeting were the following: Ansonia Brass & Copper company, Holmes, Booth & Haydens, Bridgeport Brass company, Alfred F. Moore & Co., Philadelphia; Wallace & Sons, Ansonia, Conn.; John A. Roeblings & Sons, Trenton, N. J.; American Electrical works, Providence, R. I.; Detroit Electrical works, Edison Machine works. One company at least, which refused to go into the combination, agreed to sustain the prices which were rearranged. The new schedule raises prices about 15 per cent. The net figures are arranged as follows:

COTTON COVERED MAGNET WIRE.

		Single.	Double.
No. 0000 to 0	B & S	26	28
" 1 to 4	"	25	27
" 5 & 6	"	26	28
" 7 & 8	"	27	29
" 9 & 10	"	28	30
" 10 & 11	"	29	31
" 13 & 14	"	30	33
" 15 & 16	"	31	34
" 17 & 18	"	32	35
" 19	"	33	36

UNDERWRITERS.

No. 0000 to 8	B & S	22
" 9 & 10	"	23
" 11 & 12	"	24
" 13 & 14	"	25
" 15 & 16	"	26
" 17 & 18	"	27
" 19 & 20	"	28

WEATHERPROOF.

No. 000 to 8	B & S	23
" 9 & 10	"	25
" 11 & 12	"	26
" 13 & 14	"	27
" 15 & 16	"	28
" 17 & 18	"	29
" 19 & 20	"	30

OFFICE WIRE.

No. 12 to 15	B & S	26
" 16 to 18	"	27
" 19 to 20	"	28
" 21 & 22	"	31

ANNUNCIATOR WIRE.

No. 12 to 15	B & S	25
" 16 to 18	"	26
" 19 & 20	"	27
" 21 & 22	"	30

Chicago Phonograph Company.

The Illinois & Indiana Phonograph company of Chicago was incorporated last week. The incorporators are Green B. Raum, Frank Z. Maguire and Joseph Kirkland. The capital stock is $2,000,000. During the week exhibitions of the workings of the graphophones and phonographs were given in one of the parlors of the Grand Pacific hotel, and a large number of visitors were interested in the instruments. The company proposes to operate in Illinois and Indiana. Instruments will be rented from the American Phonograph company, and will be subrented to subscribers at $40 per year. For this amount the little machines will be kept in repair, and will be provided with such improvements as are made from time to time. The company expects to secure instruments soon after December 1st.

Williams' Engine at Edgewater Station.

The illustrations in connection are of a Williams tandem compound engine at Edgewater, Ill., in the station of the Edison Electric Light company.

Fig. 1 is a view from a photograph of the engine when set up ready for service, and gives a clear conception of its general form and outward features.

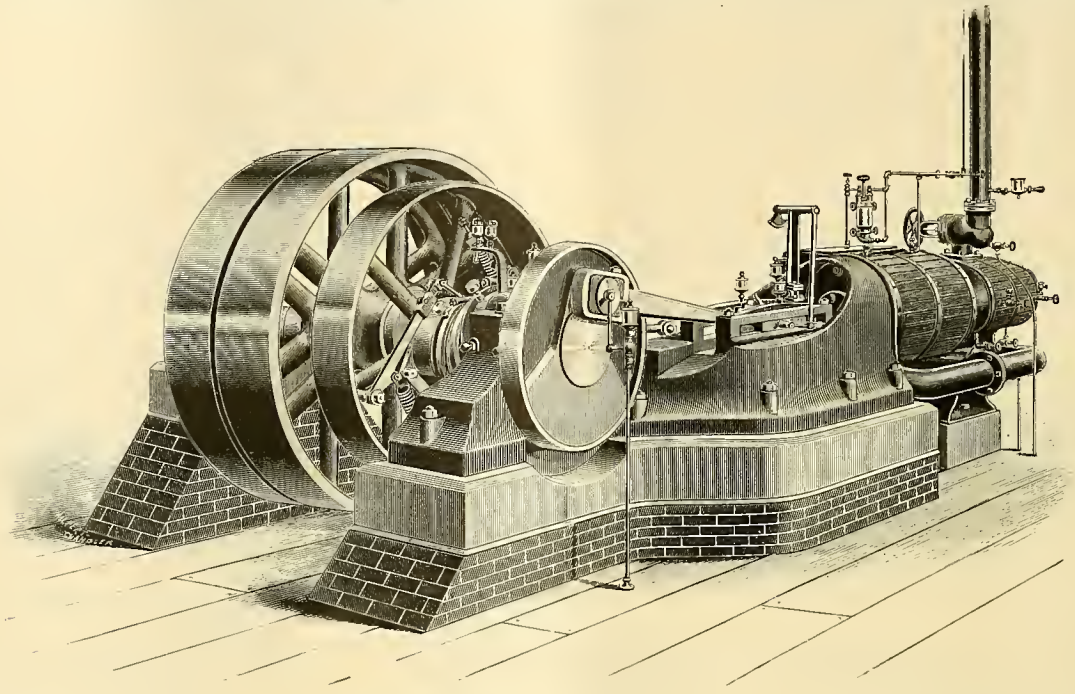


FIG. 1.

Some of its dimensions are as follows:

Diameter high pressure cylinder	9¼	inches
Diameter low pressure cylinder	16	inches
Stroke of both pistons	16	inches
Diameter of driving wheels	62	inches
Face of driving wheels	12½	inches
Weight of each wheel	1,900	pounds
Weight of entire engine	17,000	pounds
Wheel force in foot-pounds, per second	1,816,800	
Required m. e. p. of both cylinders reduced to terms of low pressure piston area, when doing 100 i. h. p., and speeded at 280 revolutions per minute, is	21	pounds

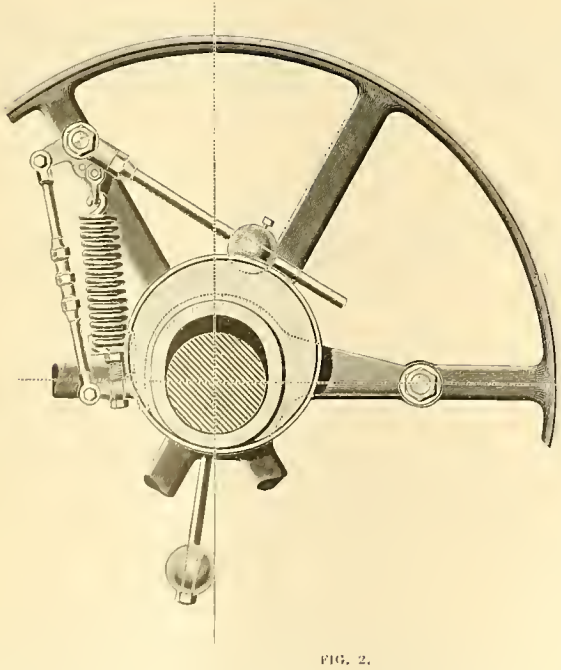


FIG. 2.

The governor was originally intended by the designer, Ed. F. Williams, of Fairbanks, Morse & Co., Chicago, for single valve regulation. He has adapted it, however, to the double valve service as well, in which case the eccentric operates a cut-off valve within the main valve.

The travel of the cut-off valve within the main valve is the same in extent for the latest and earliest cut off. At intermediate points the travel is reduced to a small extent.

The governor is composed of one weight arm, one spring and one link, which may move the single eccentric in a manner across the shaft, the eccentric being pivoted to one of the governor casing arms, as shown to the right, in Fig. 2. Opposite the eccentric center is a counter-weight also, which acts in a similar manner to a counter-weight placed in a crank disk. It serves to counterbalance the weight of the cut-off valve and valve gear. In practice it is made of such weight, and placed at such distance from the center of rotation, that its centrifugal force will overbalance the inertia of the valve gear. This counter-weight therefore not only neutralizes the thrusts of the valve gear due to its inertia, but in a sense reverses the effect, and converts it into one of the regular governing forces.

It will be seen that the eccentric and weight arm move in opposite directions. By proportioning the respective weights inversely as the purchase, one becomes a gravity balance for the other.

The tabulated data show the results of tests made by Leonard & Izard. No special pains were taken to place the governor in best trim. The table probably represents the average every-day performance of the governor. The tachometer readings are probably correct. As to the special indicator readings, it is easy to lose or gain one or two revolutions per minute in the use of this instrument.

Time.	Steam.	Amperes.	Tachometer.	Speed Indicator.	Vacuum.
4.40 P.M.	70	40	227	260	..
4.47	61	47	226	...	..
4.50	56	48	225	257	21
4.55	54	70	225	255	20
5.	55	92	225	256	20
5.5	54	108	224	255	20
5.10	50	124	224	255	20
5.15	55	135	225	258	20
5.20	58	181	225	257	19
5.25	57	180	224	255	20
5.28	50	180	224	255	20
5.31	45	189	224	255	20
5.35	50	201	224	254	19
5.40	66	215	226	257	20
5.45	78	219	226	256	20
5.50	70	225	224	254	20
5.55	67	224	224	255	2'
6.	74	227	226	257	20
6.5	61	228	224	254	20
6.10	67	230	224	254	20
6.15	65	226	225	255	21
6.20	74	226	225	256	20
6.25	67	223	224	254	20
6.30	58	227	224	254	21
6.35	57	230	223	253	20
6.40	55	233	225	255	20
6.45	45	221	223	253	20
6.50	52	219	225	253	20

An Injunction not Gran'ed.

In Cincinnati recently Judge Peck denied a motion for a preliminary restraining ord r in the suit instituted by the C., C., C. & I. Railway company against the Edison Electric Illuminating company. In the decision the following facts were stated: The defendant is operating its light plant in basement of 94 West Fourth street. The plaintiff is occupying the firs' floor under a lease from the same landlord, in which it agreed to raise no objection to his leasing the basement for the operation of an electric light plant, with privilege of maintaining a smoke-stack in the rear of premises. Plaintiff complains of heat and noise from the boilers and machinery, and of smoke from the stack, and of steam and dangers of fire and explosion. The court was of opinion that it did not appear as to the heat and noise, but that it was naturally incident to the operation of the electric light plant which defendant had put in the premises with knowledge of plaintiff two years ago, the defendant in taking its lease and in putting in its plant having relied upon the clause in plaintiff's lease that it would raise no objection; that this, if not a covenant of which defendant could avail itself, was a representation binding against plaintiff when upon the faith of it defendant had acted. As to the smoke and steam, it was the same—the plaintiff had given privilege for a stack. The court was not satisfied that the apprehension of loss of life from explosions expressed by plaintiff's witnesses was well grounded, and the conclusion was the same as to dangers from fire.

Ferranti Dynamos at Grosvenor Gallery.

A remarkable installation is that at the Grosvenor gallery central lighting station of the London Electric Supply corporation in London, Eng. It was at the Grosvenor gallery that the transformer system may be said to have had its birth. Says London *Electrician* in its preface of a description of the plant: The installation has been regarded from the first by its promoters as experimental in character, and it is here that the problems have been worked out whose successful solution has imparted that remarkable degree of confidence which is now being displayed in the far vaster undertaking at Deptford. Considered merely as an extended trial of the overhead system of distributing electric lighting currents, the success attained is of highest importance.

The total number of lamps at present wired in connection with the station is equivalent to about 35,000 of 10 candle power; but it has hitherto been found that 20,000 represents the maximum number in use at one time, and this number is but rarely exceeded. To supply current for these lights, two Ferranti machines are provided, each of which was designed for 10,000, 10 candle power lamps, but one machine alone has proved itself capable of taking a load of no less than 19,500 lamps without injury. These machines stand 9 feet 6 inches in height, with a floor space 9 feet by 11 feet. The armature is not built up in the way usually associated with the name of Ferranti, but is composed of separate bobbins, after the Siemens type. The coils are wound on laminated cores of gun metal and German silver, and are composed of copper tape ½ inch in width by .06 inch in thickness. The tape is slightly corrugated in order to prevent its slipping on the crown of the core, which is also corrugated to receive it. The insulation is wound on with the tape, and consists of hard vulcanized fiber of ½ mm. thickness. One end of the bobbin is soldered to the core, which is insulated from the frame by blocks of ebonite held in cast iron clamps. There are forty coils, each consisting of 25 turns, connected 20 in series and two in parallel, so as to keep the points of maximum difference of potential at the opposite extremities of a diameter. The diameter of the armature is 8 feet 6 inches, and its resistance when hot 1.1 ohm, which at 2,400 volts gives a loss of only 7,000 watts, or 1.36 per cent, on the maximum output. The speed is 260 revolutions per minute, which is equal to a peripheral velocity of 6,942 feet per minute. The field magnets are eighty in number, and are set very close together, forty on either side. The coils are connected in eight parallels, and have a resulting resistance of one ohm nearly. The field magnets weigh 17 tons, the base plate 13 tons, the pulley, which is 5 feet diameter, weighs 2 tons, and the armature one and a half tons.

The exciters are shunt wound Siemens machines, giving 100 volts and 108 amperes; they are coupled direct to the shafts of the Ferranti dynamos. The latest addition to the plant is a twelve-unit Kapp machine, also shunt wound, which is at present used chiefly for lighting the engine room, but is also intended as a reserve for the exciting current in case of need. Switches are arranged for this purpose. There is a constant oil service for each of these machines; the tank holds 300 gallons, and the circulation is effected by two Worthington pumps. Castor oil is used, and the used oil is returned through two strainers.

The regulation of the dynamos is effected solely by the governing of the engines. Ordinary centrifugal governors are used, and the speed is regulated in accordance with the indications of a Cardew voltmeter by means of a weight sliding on a lever arm. Nothing is more striking in the whole installation than the simplicity and effectiveness of the governing arrangement. The Cardew voltmeter is used only as a "voltascope"—that is to say, it is connected with a small transformer, and its indications are on an arbitrary scale.

The current passes directly from the machines to a pair of Sir William Thomson's ampere balances, capable of measuring 250 amperes. The maximum current taken off each machine is about 210 amperes. The machines are run independently—that is to say, they are not electrically coupled in parallel. The external circuits are five in number, and the main switches are specially designed by Mr. Ferranti for breaking on the high tension of 2,400 volts. The break is no less than 4 feet in width, and is made with great rapidity. The main fuses are each about two feet in length and consist of tin wire, several fine wires being joined in parallel. They are mounted on plugs provided with long ebonite handles, by which they can be readily replaced. It is, however, a very rare event for a fuse to go off.

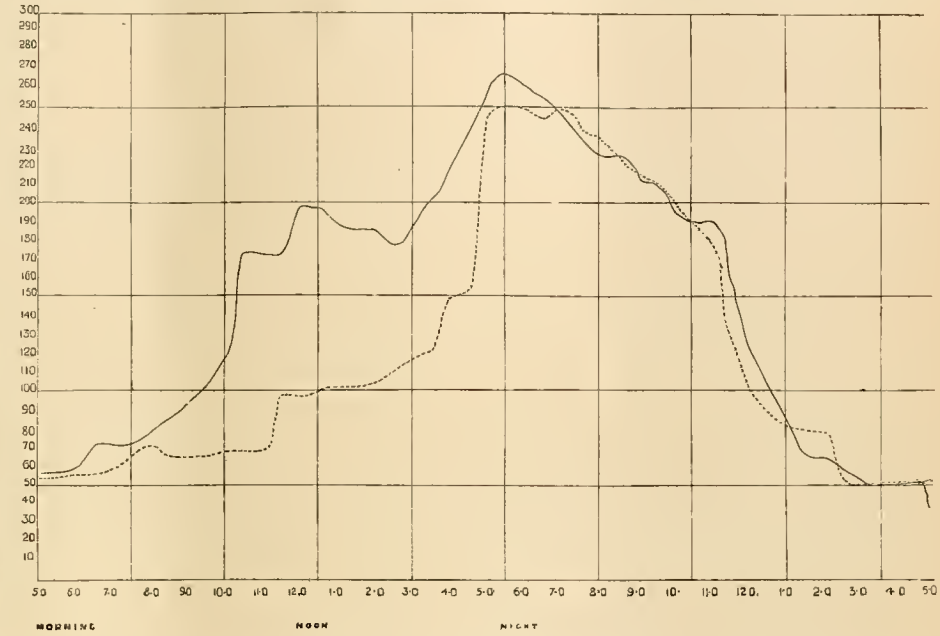


FIG. 2.

The main wires on the overhead circuit are all of 19-15 strand cable, insulated with rubber and braid, suspended by leather thongs from 17-16 steel cables. The thongs are about 7 inches in length and ¾ inch wide. The steel wire is shackled off at each pole, and oil-cup insulators are now exclusively employed. The insulation resistance of the line amounts as a rule to about 3,500 megohms per mile.

On the roof of the gallery is a main derrick of iron lattice work, designed for twelve separate circuits. On ordinary housetops iron poles of 3 3-8 inches diameter are employed, and let into cast iron sockets in the usual manner. All streets are invariably crossed at right angles. The return wire is carried over the same line at a vertical distance of 1 foot below the positive lead and not the least disturbance is now complained of on adjacent telephone circuits. Branch wires are usually 7-16 strand, and house wires 7-20. The external house wires are inclosed in earthenware piping which is usually let into the wall. Before joining the transformer they pass through a safety fuse and a main switch. The junction of the primary wires with the transformer is made at the bottom of a deep groove in the outer casing of the transformer, and can only be got at by a screwdriver of extra length.

On the consumer's premises the transformers are inclosed in a fire-proof casing, and are fixed in cellars or outhouses or wherever a convenient place can be found. The main switches in the consumer's premises are all of the double-pole type, the break being made instantaneously on each side. The insulation between the primary and secondary of the Ferranti transformer is remarkably high. The core is first wound round with several layers of linen soaked in shellac, each layer being allowed to dry slowly. An outer coating of shellac paper is put on, and over this the secondary coil is slipped. The primary coil is usually made in twelve sections connected in series so as to distribute the potential as much as possible; sections are separated with shellac paper. The primary is insulated from the secondary in the same way as the secondary is insulated from the core. As a rule the transformers are designed for 100 volts at the secondary terminals. From these terminals the house wires

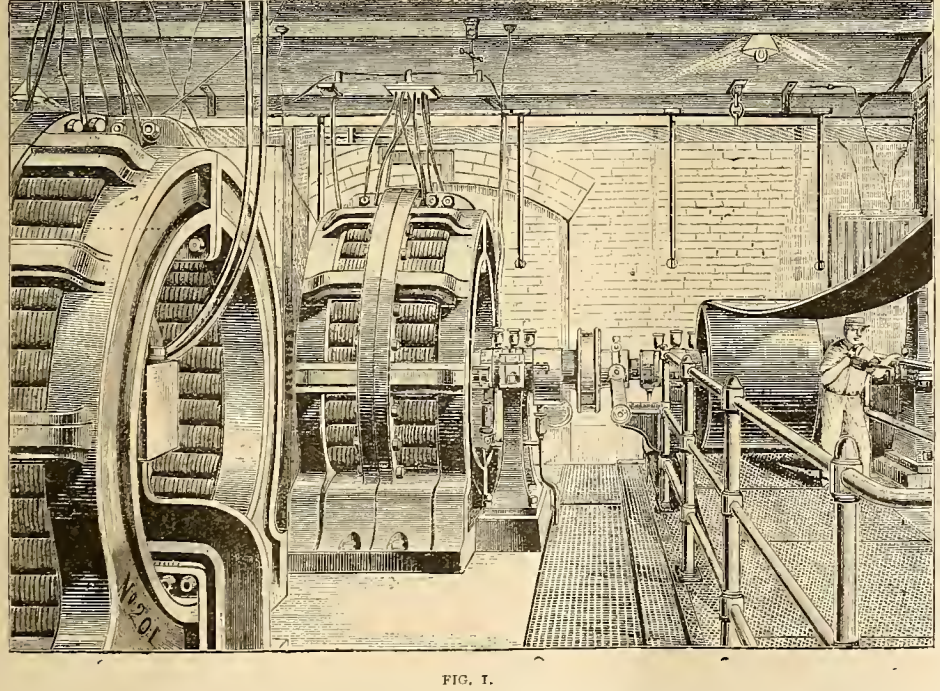


FIG. 1.

are taken to the meter, and from the other side of the meter the wires are the property of the customer, and the responsibility of the company ceases.

By far the greatest number of the lamps supplied are 10 candle power incandescents; there are, however, a few sunbeams, and about 14 or 15 arc lamps. Most of the latter are employed by photographers and are regulated by hand.

Fig. 1 is a view of the dynamo room and shows the two large generators.

Fig. 2 is a plat of curves of current output, the dotted curve having been taken on a Monday, and the upper curve several days later when there was a dense fog. It may be as well to add that the ordinates representing current may be interpreted in lamps on the basis of about 4,000 lamps for each 50 amperes of the primary current.

Bell Hangers' Hand-Book.[1]

By F. B. Badt.

PART VIII.

RUNNING ELECTRIC WIRES.

Chapter LVII.

Proper Installation.

The most important part of any electrical apparatus placed in houses is the proper running, connecting and insulating of the wires.

The apparatus itself may be perfect, and still innumerable troubles may be caused by the improper condition of the wires. If a call bell does not ring when the button is pressed if a burglar alarm sounds a warning at the wrong time and fails to go off at the right time, in ninety-nine cases out of one hundred the attendant will find that these surprises are caused by the wires which are either poorly insulated or not properly put up.

It is worth the money every time if one purchases electrical apparatus to purchase the best and have it set up and put in operation by the best skilled workmen, in the most thorough and scientific manner. These men are generally found in the employ of the large electrical companies, who of course, are responsible for their work.

In nearly all the departments of domestic application of electricity, described heretofore, number 18 or 16 Brown and Sharpe gauge wire is used. This wire is generally double wound with cotton and paraffined. It is called annunciator wire. This wire can be bought in almost any color to match the color of walls or ceilings. It will answer in all dry places; in damp or moist places, wire with a perfectly waterproof insulation should be used. Dampness on non-waterproof wires will cause leakage of electricity to earth, exhaust the battery in a very short time, and destroy the wire. The insulation of the wire must therefore be perfect, and should always be tested before an installation is considered perfect. The method of testing is treated in Chapter LVIII.

FIG. 82.

Splices in wires if absolutely necessary should be made after the fashion of telegraph splice. Fig. 82.

It is best, however, to solder the splices. Do not apply tape to *hare* wire splices; either solder splices and tape, or cover well with paper and then tape. Tape will corrode and rust bare splices that it comes in contact with. When acid is used for soldering, the joint should be thoroughly cleaned with an oily rag before taping it.

Parallel wires should be kept at a distance of at least one-half inch apart. They are often fastened to the walls or ceilings with small staples. Never use one staple to fasten more than one wire. It looks better to "fish" the wires under the floors, above ceilings, and between the lathing of the walls. Great care should be taken to avoid the abrasion of the insulation to prevent leaks or crosses.

Chapter LVIII.

How to Fish Wires.

Punch a hole through the plastering at the required position, being careful that there is no studding at that place Use a brad-awl, and cut the hole large enough to set in the push button plate. With a short length of small brass spring wire, push through the opening a few inches of number 19 double jack chain, such as is used for general fishing purposes, first having connected the end of the chain with a piece of heavy linen thread. Run out the thread between the laths and the outside wall until the chain touches the floor beneath; move the thread and locate the chain by the sound. Bore a hole through the base board or floor, as the case may be, toward the chain. Use a two or three-foot German twist gimlet. With a small brass spring wire, bent at the end in the shape of a hook, fish for the chain and draw it out. At the other end of the thread attach the wire and draw it through with the thread. Passing under the floor, bore a second hole through the floor as near the other as possible. Run into this a piece of snake or fishing wire, which is 1/8 x 1-64 inch steel wire, with a hook at the end, until it comes to an obstruction. Locate the obstruction by sound. In running wires under the flooring, first carefully examine all parts and find the direction in which the beams and timbers run, and run the wires parallel with these. After locating the end of the fishing wire, see if the obstruction is a timber; if so, find the center and bore from the middle diagonally through it in the direction of the fishing wire. Drop the jack-chain and thread through the hole; fish for it and draw it through hole number 2, attach the insulated wire and draw it back. Starting at hole number 3, bore hole number 4 diagonally through the timber in the direction in which the wire is to be run, making holes numbers 3 and 4 form an inverted V through the timber. Run the fishing wire through hole number 4 until it meets an obstruction. If at the end of the room, bore through the floor, drop the chain, fish it out, attach wire, and draw it home. Putty up holes after having done with them; or in case of hard finish, plug them up with wood. In lightly built houses, it is often found easier to take off the moulding above the base board and run the wire under it. In such cases care should be taken to break off the old nails, as any attempt to drive them out would cause a bad break. In closets and around chimneys it is usually found easy to work. A mouse or lead weight attached to a string may often be dropped from the attic to the cellar ceiling through the space outside the chimney. It is well before starting on a job to carefully examine the whole house, and find the easiest places to run in. When necessary to take up carpets, be sure and put them down again as quickly as possible, in order to reduce to a minimum the inconvenience to residents.

Chapter LIX.

Wiring Fixtures for Gas Lighting.

Where it is impossible to run the wire between the gas-pipe and the outer shell, run it above if the fixtures are overhead; below, if the fixtures are low down, and bind the wire close to the fixture with fine thread, being sure that the sharp corners will not cut through the insulation and eventually cause a ground. Shellac the wire to the pipe, and when hard remove the thread. At the joints or hinges connect the nearest set points by means of a wire loop of sufficient size to in no way interfere with the action of the fixture, and wind the insulated wire around this loop in the form of a spiral. Great care should be taken that perfect insulation be obtained, and in all such parts the wire should be covered with rubber tape. In running wire between the gas pipe and the outside shell, the same care should be exercised to guard against grounding. To pass the rings and other sections where there is not sufficient space, bore through with a small monkey drill, or punch a hole with the brad awl, or file off sufficient metal to allow an exit; if necessary, run the wire through and over the obstruction. Rubber tape must be used wherever the wire passes near the metal of the fixture or is liable to touch it.

Chapter LX.

Wiring Elevator Annunciators.

Care must be taken to have the cable swing freely so that the cab will not interfere with it. Some slack must be left too, so that when the elevator is clear to the top or bottom of the well the cable will not be pulled tight. The usual method is to suspend one end of the cable midway between the top and bottom of the elevator well, and run the other end of the cable to the bottom of the cab, fastening each end securely, and then splicing the wires on to the conductors of the cable.

The battery is usually placed in the basement, and the wires run along one side of the well from the end of the cable to the battery and push buttons.

Chapter LXI.

Best Time for Wiring.

The best time to wire a house is when the builders have finished boarding-in and not yet begun lathing. The cost of wiring at that time is very much less, sometimes not more than one half as much as in the finished structure. In houses already occupied, the inconvenience caused by

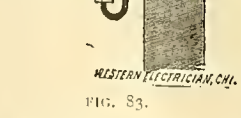


FIG. 83.

putting in the wires is slight. Little or no dirt need be made; there need be no hammering and pulling away plastering, laths and floors. The most expensive finishing should in no way be injured by the workmen. When the job is completed, and well done, it will be difficult to discover evidence of the work having been done.

Sometimes it is necessary to run wires for a distance outdoors. In such cases the wires should be fastened to porcelain, hard rubber or glass insulators. No smaller wire than number 14 B. and S. gauge should be used outdoors. Smaller wires are too easily broken.

In conducting wires into houses, great care must be taken to prevent rain following them. The wire should be fastened to the insulator below the point where it is intended to be led through the wall or a window frame, so the rain would have to run up hill in order to follow the wire, Fig. 83.

An extra heavy insulating material, such as rubber hose, or porcelain, or hard rubber tube, Fig. 84, must be put over the wires where they pass through walls or partitions.

In some cases it becomes necessary to run circuits under ground. Perfectly waterproof and lead covered cable should be used. If the earth is used as a conductor, great care should be taken in getting a good ground connection as described in Chapter LV.

When a very high e. m. f. is employed in circuits, as for

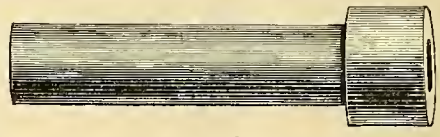


FIG. 84.

instance, in electric gas lighting systems in public buildings, the insulation should be the very best and heaviest, otherwise the electric current will puncture it and leap across from the wire to the nearest object. For running these wires on walls or ceilings, only porcelain or hard rubber insulators must be used. For currents of very high e. m. f., such as those generated by large induction coils, rubber pins with base plates are used. Fig. 85 shows such a pin. The base is screwed to the wall, the pin projecting about three inches. The wire is then fastened to the top of the

FIG. 85.

pin. Very thin *bare* wire, about number 26 B. and S. gauge may be used with these pins; this will make a neat looking job, as the wire will be almost invisible.

TESTING INSTRUMENTS.

Chapter LVIII.

Detector Galvanometer and the Magneto Bell.

The detector galvanometer, Fig. 86, in connection with a galvanic cell, is used for testing the insulation of the wires and apparatus, and for locating other faults. The detector

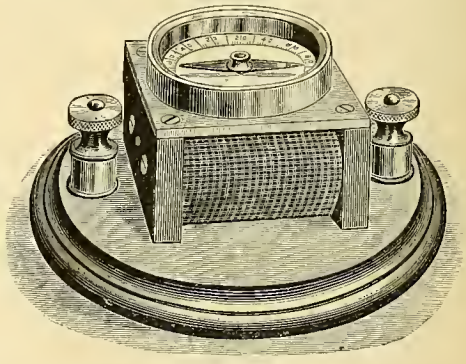


FIG. 86.

galvanometer is a compass, mounted on a coil of wire. An electric current passing through this coil will deflect the needle of the compass, as has been explained in Chapter XXXV. Of course, a coil will cause a greater deflection of the needle than a single wire as the current is forced to pass a number of times under the needle.

In order to test for insulation with the galvanometer, con-

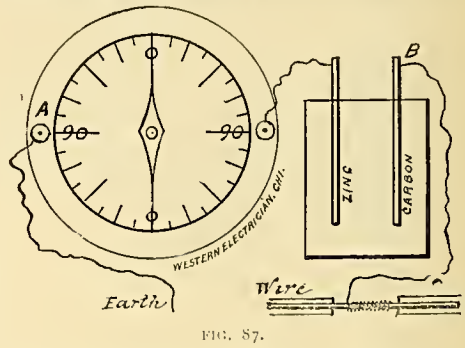


FIG. 87.

nect the galvanometer and the galvanic cell in series, Fig. 87, and connect one wire, starting from binding post *A* to a ground—gas pipe or water pipe—and the other starting from *B* to the wire to be tested for insulation. If the needle deflects, the wire is grounded; if it remains in its position the insulation is in good condition. It is well to connect wires *A* and *B* for a minute before testing, and see whether cell and galvanometer are in good condition. In connecting the wires the insulation must be carefully removed and the wire perfectly cleaned by scraping with a knife or by rubbing with a piece of emery cloth. Connections must always be made with clean metallic surfaces. In the same

[1] Bell Hangers' Hand-Book, by F. B. Badt, author of Dynamo Tenders' Hand-Book; ready in book form, with additional chapters, December 10th; about 100 pages, 80 illustrations; flexible cloth binding; type page 6 inch[illegible] All rights reserved.

way a break in the circuit can be found. Cut the circuit in several sections and connect the ends of each section to *A* and *A*. When the needle deflects, there is no break in the circuit; if it does not deflect, the circuit is open.

Fig. 88 shows one form of portable galvanometer, combining galvanometer, battery and wire.

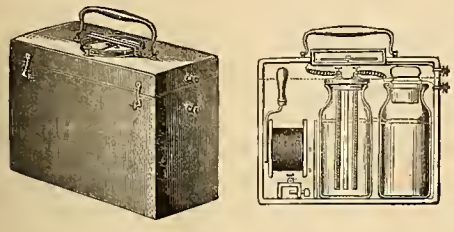


FIG. 88.

Very often a magneto bell, Fig. 89, similar to that used as a call for telephones, is employed for testing When the bell rings the circuit is closed; if it does not ring the circuit is open. This is all it can tell, while the detector galvanometer, if properly handled, can tell very much more. A de-

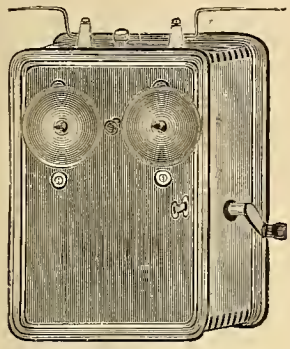


FIG. 89.

tector galvanometer can be carried in the pocket and rarely gets out of order, and a galvanic cell is always useful where circuits are to be tested.

The galvanometer can also be used to test the battery to ascertain whether it is in good order or not. If, for instance, one good cell will give a deflection on a certain galvanometer of say 10 degrees, this may be used as standard for te ting other cells.

Chapter LIX.

Tests for Faults.

For the guidance of those who have to test circuits or apparatus for faults, the following suggestions are offered:

1 *Insulation of Wires.* The manner of making this test has been explained in Chapter LVIII. If the earth is used as a conductor or as it is generally termed, as the return, the wires connecting to earth, i. e gas or water pipes, must be disconnected before this test is made,

In fact, in a new installation this test should be made before the earth connections are made.

2. *Breaks in the circuit.* See Chapter LVIII.

3. *The call bell does not ring.* First ascertain, if there are more than one push button, whether the bell answers to all but one push button, or to none In the first case the circuit leading to that one particular push button is broken and must be tested. If the bell answers to none of the push buttons, the source of the trouble may be in one of several places.

a. The fault may be in the battery.—Disconnect the wires leading to the bell and push buttons from the battery and test it with the galvanometer. If no deflection or a very small deflection is obtained, the battery is exhausted. As this may be caused by the breakdown of one single cell, when the cells are connected in series, disconnect the cells and test each separately. If a fault is found, renew the battery.

b. The fault may be in the bell.—If the battery is found in good order take down the bell and attach it directly to the battery. If it does not ring, a connection inside may be loose or broken, or the adjusting screw of the vibrating bell may be turned back, not making contact with the spring, or the contact points on the spring or the adjusting screw are bad.

Tighten all connections, change the adjustment by means of the screw and scrape contacts clean. If this does not remedy the fault, the wire on the magnet may have come in contact with the iron frame or may be short-circuited by moisture. Test each part separately by means of galvanic cell and battery.

c The fault may be in one of the wires leading from the battery upward.—If both battery and bell are found in order, and after connecting the battery and putting the bell back in its place, the bell will not ring, one of the wires leading from the battery to the bell is broken. This break must then be located as described.

d. The battery always gets exhausted in a short time.—This is generally caused by poor insulation of the wires, causing leakage. The circuits should be tested for grounds.

Sometimes the bell will ring for half an hour or so without pushing a button and then stop. Pressure on a button will then not cause the bell to ring. This is caused by a short circuit between the outgoing and return wire. Such a short circuit, of course, will exhaust the strength of an open circuit battery in a very short time. This fault may not only be found in the wires, but in the push button itself.

The ebony push may stick and cause the two springs to remain in contact, or the push button may not be fastened well and the screws holding the push to the wall may short-circuit the wires, or in pushes with metal covers the latter may touch both springs. A good push properly put up cannot cause any of these troubles. If the earth is used as return, grounding of one outgoing wire will of course cause a short circuit of the battery. It is therefore advisable to reduce the number of these chances for trouble by always using one metallic conductor as a return instead of the earth.

5. *The bell does not ring as loudly as usual.*—This is caused, of course, by the weakening of the current which may be caused by various means as explained. A bell should not have too much battery as this will cause too much sparking on the platinum contacts, and burn them very rapidly.

(Concluded.)

British Association.

Discussion of Electric Lighting Subjects.

Major General Webber said the association must not run away with the idea that distribution by accumulators in the old time represented all that had been successfully done in that direction; indeed, it was certain that in both those cases there was not success, and that since then until Mr. Edmunds came before them that day no attempt had been made to use accumulators, On the contrary, it was only necessary to look at Mr. Crompton's work at Kensington to see that the subject had been well worked out in at least one instance. They must reduce the value of Mr. Edmunds' invention to the extreme ingenuity with which he had designed his distributor; the rest of his system might be fairly said to have occurred to many, who had only been deterred from proceeding on the same lines by the great cost of accumulators and by the natural objection of experienced engineers, who dealt with electricity, to automatic apparatus intended to work without supervision. It must not be forgotten, however, that those who were looking forward to accumulator stations, where accumulators would be concentrated, did not believe in automatic instruments, especially if a number of them was to be used in the system. They proposed to place two or three thousand accumulators at one station and distribute thence to the surrounding neighborhood. That was not Mr. Edmunds' object, and he could see very little *raison d'etre* for the latter's system. He thought, as an admirer of Mr. Edmunds and a strong advocate of the objects he had in view, that it would have been better in all respects, for electricity and himself, if he had waited twelve months and then reported that his system had been working and had done its duty. Then, and only then, could they regard his invention as coming within the range of practical use.

Mr. Kapp said the question of the best potential to use was a very important one, and one which ought to be settled, if possible, by the association or the Society of Telegraph Engineers and Electricians, so that a contractor who had to put up a central station might have a choice of apparatus from various makers. It might be very important to be able to order transformers by telegraph without having to specify period or potential and yet be sure of getting the right thing; but the tendency in England was, with plants of moderate size, to go for 2,000 volts. Mr. Ferranti, he believed, went as far as 10,000 volts, but his station stood by itself. It might be that they were all wrong in accepting 2,000 volts, but unless there was some clear evidence on the point, the introduction of the 1,000 volts potential would result in a double standard, which was very undesirable from a commercial point of view. Therefore, unless Prof. Forbes could show some substantial reason for the adoption of 1,000 volts, he thought they should stick to the 2,000 standard. Prof. Forbes said that under the Westinghouse system, although they could couple two machines in parallel, they did not like to do so. Now, the current must be on night and day, every minute and every second, and he would like to ask, if they did not couple two machines in parallel, how could they change the machines from one circuit to another, and how could they prevent the interruption of the light for a few seconds? And those few seconds in a theater would be sufficient to create a panic. Therefore he thought their endeavors should be directed to find a way of coupling in parallel. Dr. Hopkinson had shown theoretical reasons why it should be done; Prof. Adams had done it at South Foreland, and Mr. Westinghouse in America; Zipernowski was doing it in all his installations, and if they could do it surely others could also. Did the transformers get hot, so hot that the hand could not be borne upon them? That was a great failing with transformers he found. He could see now why it was so. Sir William Thomson had told them that they lost the advantage of thicker copper beyond a certain point. The question of period was also an important one, but he did not think it was wise to go too fast. He began with 12,000 complete cycles a minute, and he had gone down by steps until he had arrived at 9,000 alternations; no great amount of iron or copper was wanted, but they had the advantage in the dynamo. The Westinghouse dynamo was much heavier than any English dynamo of the same output.

Prof. Forbes said he quite agreed with what Sir William Thomson had said about accumulators. He had always felt that accumulators would be very desirable if they had the qualities which Sir William mentioned. Accumulators were now working extremely well. They had fulfilled the conditions, so far as that was concerned, already, but unfortunately they were still far too costly, a matter which he hoped would soon be remedied. Sir William asked him about the working in parallel of the alternate current machines. Of course it was known that they could be run in parallel, and there had been various little experiments that they knew of in this country showing that alternate current dynamos could be run in parallel. He knew that in the old days of the Grosvenor Gallery it was tried with Siemens machines, and he knew that it failed. Driving from the same engine, but with different belts to two dynamos, they could not get them to work in parallel. But the Westinghouse dynamo could be worked in parallel, as also several others which he had seen; he had seen Thomson-Houston alternating current machines running in parallel. The reason why they checked each other working in parallel, was that the lag in phase helped to check the one that was going too fast and to check the force which was pulling against the other one which was going too slow, thus making it go faster. The amount of this force depended on the amount of the self-induction of the dynamo machine. The Westinghouse machine had far more self-induction than the Siemens, and he fancied that was the reason the American machine worked successfully in parallel, whilst the Siemens did not. At present all alternate current machines, driven each by a belt, each by a separate engine, when they are once started in unison by the arrangement which he described, would keep in unison by slipping of the belt. It was slipping of the belt which allowed them to act as checks to each other even though the engine did not vary. At the same time the checking effect was much greater when the maximum current was passing through. It was only when they were doing a good deal of work that the synchronism was perfect. If they were much under half load they got out of synchronism, and one got half a period ahead of the other sometimes If one only were under load they would not be in perfect synchronism; that was shown by the flickering of the lamps; the e. m. fs. of the two machines would then be nearly opposing each other. There was no difficulty about running in parallel. In America it was believed that the durability of the lamp was very much greater with the smaller potential. Indeed, he thought that the very fact that, though before they had alternating current machines they urged makers to go to as high tension as they could, they had never got higher than 120 volts, was an indication that the greatest economy was not to be found in high voltage.

Sir William Thomson said if they could get over the practical difficulties in the way of using 2,000 volts, they would only need half the quantity of copper. Taking the proportion of reduction at 40 to 1, if they had 50-volt lamps, they would get twice the benefit from 2,000 volts tension, and ten times the benefit with 10,000 volts.

Prof. Forbes said it must be remembered that after a certain stage, if they went to a high enough potential, then copper was a much smaller item than when they were dealing with a low potential, when copper was chiefly to be thought of. But it occurred to him to suggest that it might be a possible thing in future that they might have a number of small stations, say, up to 1,000 volts, and going to short distances, when there would be no difficulty about the copper mains, and that eventually they would be combined into one large scheme, supplied from 10,000 volts. As to the heating of transformers, 50° C. was the greatest rise allowed in temperature, and the hand could always be borne upon them With regard to the number of alternations, it was desirable that opinions should be expressed, and he hoped electricians would soon begin to talk about the matter, and come to some conclusion as to what the alternations should be It was not fair to manufacturers that electricians should be undecided on that point, for it put a difficulty in the way of their constructing dynamos suitable to the requirements,

Mr. Edmunds, replying to the criticisms upon his paper, said Sir William Thomson pointed out the advantages of accumulators as compared with transformers, and he had some figures there, which were only approximate, but, he thought, rather interesting as bearing on the actual cost of an installation of certain dimensions. The estimated cost of plant for 10,000 10 candle power lamps would be about £25,000, and at 6d. per unit the light would be equivalent to gas at 3s. 11d, per thousand feet, and that would give a probable profit on the capital of 21 per cent. If they went to a larger plant of 15,000 lamps they would find the cost to be about £37,000, and that would be equal to gas at about 3s. 6d. per thousand feet A plant of 20,000 lamps would give light at a cost equal to gas at 3s. 5d., and 40,000 lights would be equal to gas at 3s, per thousand feet. With regard to voltage, from the experience he had had he should say the lesser voltage would be more generally suitable than the higher one, for several reasons. With the lesser voltage they could have lamps of smaller candle power than otherwise. In some cases it was very useful to have a one, two, three, or four candle power lamp, and the lower the voltage the better could these small candle power lamps be made. With regard to their longevity, he did not think there was much in it.

Mr. Lowrie said that about 50 or 60 of his meters were now in use, and one had been working for eight months. They were checked and tested very carefully. One gentleman, a consumer, kept a very careful check against the company by noting the number of hours during which the current was used, and he said that the amount they had charged him with was within half an hour of his own computation.

W. H. Preece said he wished to protest against the assertions that were made that the whole of the inaction in England was due to the Act of 1882. That act had in no sense interfered with the action of the corporation. There were 60 or 70 corporations in this country who took provisional orders under that act and never carried out the provisions of those orders. The fact was that the system of electric lighting had not then and had not even now, sufficiently advanced to justify corporations in investing the money of the ratepayers in electric lighting enterprises. And he was very glad they had not gone ahead. He went to America four years ago and came back with a species of Yankee mania. It was impossible not to be impressed by the go-aheadedness of Americans; but when they came back and settled down again they could see that in this country they were, after all, progressing more surely, if more slowly. With regard to the relative advantages of 100-volt and 50-volt lamps it was a question of great importance, and he should make a strong recommendation to the Institution of Electrical Engineers to form a committee to take into consideration the relative advantages of different voltages. At present he was strongly in favor of 100-volt lamps.

(Concluded.)

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

PAGE.

A Burglar and Fire Alarm, Illustrated 277
Fort Wayne Jenney Works Destroyed by Fire..... 277
Combination in Wire..... 277
Chicago Phonograph Company..... 277
Williams' Engine at Edgewater Station, Illustrated..... 278
Ferranti Dynamos at Grosvenor Gallery, Illustrated 279, 280
Bell Hangers' Hand-Book, by F. B. Badt, Illustrated, Part VIII., Concluded:
Running Electric Wires..... 280
Testing Instruments..... 280, 281
British Association, Discussion of Electric Lighting Subjects, Concluded 281
Editorial 282
The Book Table..... 283
The Grove Electric Meter, Illustrated..... 283
Watchman's Clock and Fire Alarm Indicator, Illustrated..... 283
Interesting Motor Installation..... 283, 284
The Curtis Pressure Regulator, Illustrated..... 284
Ohio State Tramway Association 284
New York Electric Club..... 284

DEPARTMENTS.

Correspondence 284, 285, 286
The Electric Light..... 286, 287
The Electric Motor..... 287
The Telephone..... 287
The Telegraph..... 287
Electrical Patents 288

It will be seen from an article on another page, that a Chicago company has entered heartily into the phonographic field. The instruments have excited no little interest in Chicago.

It will be noticed that a new combination in wire has been formed. It is asserted that the organization is much stronger than any previous combination. A number of contractors who have not purchased wire for work just commenced are expected to suffer.

It is gratifying to know that business in the electrical field is unusually good. In spite of the excitement incident to election, a prosperous fall trade was carried on. Most of the gentlemen connected with electric interests in Chicago, assert that they have about all the business they can transact.

The fire which destroyed the Fort Wayne Jenney company's factory last week, was one of the most disastrous, if not the most serious, which has occurred in the electrical field. Never has a plant of the kind been so completely wiped out. It is understood that the company proposes to commence at once the work of rebuilding the works.

It is with great regret that we have learned of the sad bereavement of W. J. Johnston, publisher of our contemporary, the *Electrical World*, in the sudden death of his wife at the family residence, Annandale, Greenwich, Conn., Friday, November 16th. Mrs. Johnston, up to eight days before her death, had been enjoying her usual good health. She was then stricken by inflammation of the brain and despite the combined efforts of eminent physicians, reinforced by her naturally strong constitution, she was compelled to succumb. Mrs. Johnston was but thirty years of age and leaves five young children to mourn the loss of a cherishing and loving mother. Mr. Johnston will accept our most sincere condolences in his grief.

An invention of Thomas D. Lockwood, which is briefly described under the head of electrical patents, will be of special interest to those who work in the field of practical telephony. The instrument which Mr. Lockwood has invented is an ingenious device for the neutralization on telephone lines of the pernicious effects of induction from other circuits.

In our St. Louis correspondence, Solicitor Chandler gives his interpretation of the recent Supreme court decision in the Bell telephone case. We cannot agree with Mr. Chandler in his liberal construction of the decision. The case has not been tried on its merits yet, and the force of the recent decision is simply to send it back to the Massachusetts Circuit court for that purpose.

Twenty thousand dollars' worth of telephones and telephone appliances which infringed on the Bell patents, and which by order of the court had been turned over to the Bell company representatives, were burned at Little Rock, Ark., a fortnight ago. A bonfire of equal magnitude could have been made with a few tar barrels at a much less cost, but the Bell company is on a big scale, operates on a big scale, and when it has a bonfire, has a bonfire on a big scale.

All members of the National Electric Light association should bear in mind the fact that the experiment of a permanent office and headquarters in New York, with a secretary drawing full salary, is under trial from now until the February meeting of the association. Watch the results of this experiment closely. If it proves for the best interests of the association, it should be continued. Otherwise, the old order of things should be promptly returned to. You will be asked to vote on this question at the Chicago meeting. Therefore keep posted.

The Grosvenor gallery installation in London has long been an object of interest to electricians, more especially as their curiosity in regard to its internal workings has up to within a few weeks remained unsatisfied, as all except those employed about the station have been refused admittance. Through our London namesake, we are able to give an interior view of the station, showing the colossal dynamos of 10,000 lights capacity each, and a very clear and full description of the whole installation. There is much in the installation strange to American practice, and for this reason alone the article would be read with interest; but there are also several points which can be studied with profit, and consequently the interest in the installation will be doubled.

When the finance committee of the Chicago city council met last week to wrestle with the telephone question, it was not in as belligerent a mood as usual. This company had refused the ordinance which the council had adopted to reduce the rentals of instruments, and the committee hoped to devise some measure to bring the corporation to terms. The aldermen, however, found that their way was blocked. An opinion from the corporation counsel was read, which sustained in many important particulars the position of the company. The document was not made public, but it is understood that the corporation counsel was unable to affirm the right of the city, under the charter, to adjust telephone charges. It seemed to be the opinion of the committee that the legislature should be requested to grant the necessary powers; but what should be done in the meantime? One or two members of the committee thought it better, on the principle that a half loaf is better than no bread, to accept, as a temporary measure, the company's offer of 2½ per cent. of its gross income as consideration for its rights in the city. No definite action was taken, as it was deemed best to await another proposition from the company. The aldermen think the company should pay at least $40,000 per annum for its privileges.

Bell Hangers' Hand Book as far as its publication in the Western Electrician is concerned, is completed in this issue.

It was thought when the copy for this book received its first reading, that the field to which it was devoted was covered very exhaustively, and that the book would be of the most valuable assistance to every bell hanger in the country. But as installment after installment appeared, it was seen that the book could be made still more valuable by introducing other features and making some of the chapters more complete. This has involved much additional labor and expense but has been undertaken willingly, and within a very few days we shall have the pleasure of being able to fill the orders received for the book.

The chapters included within the last installment are, possibly, more valuable than any preceding. They are not only complete in their directions for running electric wires and testing circuits, but also contain many hints and suggestions which the reader can profitably follow.

Two serious accidents have occurred in New Orleans recently to employes in the service of an electric light company of that city. The papers are beginning to agitate the question of making the overhead system safer. The New Orleans *Picayune*, in referring to the matter, says by way of preface, "New Orleans, as is well known, uses more electricity than any other city of its size in the world, and is probably the only metropolis that is exclusively illuminated by the electric light. To keep in operation this vast illuminating system a great network of wires is required, which is strung overhead through the streets." The editorial goes on to refer to the dangers which may result from imperfect construction. But the noteworthy feature of the editorial is to be found in the fact that the writer did not insist upon the electric light companies performing impossibilities. He views the matter reasonably, and simply makes this suggestion: "Other cities have been discussing the advisability of appointing officials to supervise and inspect the electric wires within their limits, and we believe that some have already adopted such a precaution against danger. While we are not disposed to give our city officials any advice on the subject, believing as we do that they are disposed to do their full duty in the premises, still the importance of the matter is sufficient to command a greater share of attention than has up to the present been accorded it."

The storm of Monday last on the north Atlantic coast was of unusual severity. Companies which maintained overhead lines suffered great loss. In New York city 10 per cent. of the Western Union lines running east and south went down, and hundreds of poles were overthrown by the force of the gale. Other telegraph companies in the metropolis experienced great difficulty in keeping the service in operation, but the officers consoled themselves because the storm was not as disastrous as the great blizzard. The electric light companies, while they experienced considerable trouble, were able to keep their lights burning. In Brooklyn, the electric light wires went down and the central portion of the City of Churches was in complete darkness. In Boston the storm was less severe. Communication with New York was greatly hindered. Reports of the same character come from a large number of smaller places. In Danvers, Mass., if the dispatches are correct, the telegraph, telephone and electric light systems were completely disabled. The rapidity with which the companies put their lines into working order is well worthy of remark. In New York, Brooklyn and Boston, almost the entire damage had been repaired within twenty-four hours after the storm had ceased. It may be expected that a renewed demand for the burying of wires will be one of the results of the disabling of the systems.

The Book Table.

GESCHICHTE DER TRANSFORMATOREN (History of Transformers), by F. Uppenborn. Published by R Oldenbourg, Munich and Leipzig, 1888. Price 2 marks.

The object of this pamphlet is to determine the part which each individual inventor can claim in the invention of transformers, going back to Faraday's discoveries. The author has hardly given Gaulard and Gibbs the credit they deserve. Prof. Rühlmann, in a criticism in *Electrotechnische Zeitschrift*, October, 1888, pointed out that Uppenborn is mistaken in saying that Gaulard and Gibbs built transformers only with the ratio 1:1, and that their transformers could not be used in a multiple arc system of distribution.

Uppenborn is not just in his final statement: "We have now related the development of electrical distribution by means of transformers in Europe. American electricians had easy work. They simply waited until we obtained satisfactory results in Europe, and then imported the complete invention."

Did Mr. Uppenborn never hear of the independent researches of Stanley, Thomson and Slattery?

The diagram, Fig. 31, page 42, is not correct. It is supposed to represent transformers in series but the circuit is left open.

THE ELEMENTS OF ELECTRIC LIGHTING. By Philip Atkinson, Ph. D. Published by D. Van Nostrand, New York, 1888. Price $1.50.

The book is mainly a reprint of the articles published some time ago in the WESTERN ELECTRICIAN. The question: What is electricity? is for the first time very promptly answered by this author. The learned doctor is quite confident that it is a mode of molecular motion. Although he devotes fully thirteen pages to his theory he has not succeeded in convincing us.

Chapter V, upon electrical terms and units, does not carry out the announcement in the introduction, namely, that it is written in a manner that "business men, mechanics and those who have the care and management of dynamos and lamps, as well as general readers, may gain the knowledge of the principles and construction of the apparatus by which this light is produced, and of the nature of that invisible, intangible agency which is its prime cause."

The diagram on page 109 is incomplete. The connecting wire between one terminal of the upper coil and the upper brushholder is omitted.

The diagram, page 248 of the Gaulard and Gibbs series system of transformers, shows the same defect as the same cut in Uppenborn's book. Dr. Atkinson and Uppenborn seem to have copied the same defective cut.

In the list of names of the promoters of the parallel transformer system, we miss Zipernowski Déri and Blathy.

Uppenborn makes light of the merits of American electricians and Dr. Atkinson seems to try to get even with him.

There are a number of minor points which are not quite correct. On page 253 this statement appears: "If from any abnormal increase of current the temperature of the conductors rises to an unsafe degree, the fuse melts and opens the circuit, the fuses in the main and branch circuits being adjusted to the requirements of each circuit by difference of size, *which produces difference of resistance and consequently of melting temperature.*"

We have lived heretofore under the impression that the fuse should melt *before* the temperature of the conductor rises to an unsafe degree; the melting temperature in all fuses made of the same alloy, of course is the same, and *only the cross-section* of the fuse made of a given alloy determines the current in amperes which will melt it.

The whole book shows that the doctor is not quite so conversant with electric light machinery and installations as he is with electro-static medical appliances.

STEAM BOILER CATECHISM. By Robert Grimshaw. Published by Practical Publishing company, New York; 402 pages, 4 x 5½ inches; illustrated; price $2.

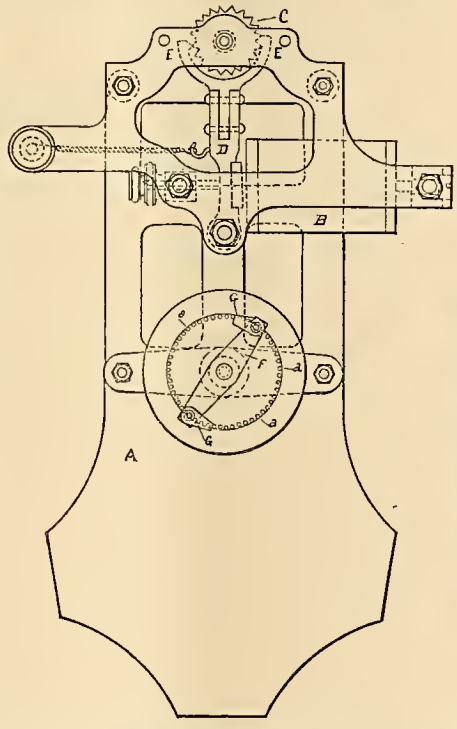
This book is similar in form to its companions, "Steam Engine Catechism" and "Pump Catechism," which have received notice heretofore in these columns.

Information is presented in the form of direct questions and direct answers; consequently the seeker for information in the book must first consult the index carefully and then turn, it may be, to several different places before he finds the specific statement for which he is in search. However, the indexing is exhaustive and presumably correct. Mr. Grimshaw has won a wide reputation for his work in the steam engineering line, and the book is in keeping with his reputation.

The Grove Electric Meter.

The accompanying cut illustrates the details of the new meter of the Grove Electric company. It does not measure the current directly, says *Mechanics*, although in an indirect manner the same result is attained. Instead of measuring the current, the instrument is constructed for the purpose of recording the time during which the current is allowed to flow, and as each lamp requires a determinate amount of current, a reliable basis upon which to fix charges is thus obtained. It is possible by this apparatus to keep an accurate record of the number of lamp-hours which may have elapsed between any two periods, and hence to determine how much value the customer has received.

The recording apparatus consists of an escapement, shown in the upper part of the frame E, the escapement wheel being at C. The pallets of the escapement are attached to a pivoted arm,



which also carries an armature, which opposes an electro-magnet, B. When the electro magnet, B, is excited, the armature, and also the lever and pallets, are moved toward it, and when the magnet loses its attractive power the lever is drawn back by a spring, as shown. Each motion of the lever causes the escapement wheel, C, to move one tooth, and if the arbor of the escapement wheel is connected to a train of index wheels provided with dials, as in the ordinary gas meter; the number of revolutions of the index wheel may be registered.

In the lower part of the frame is an insulated disk of ebonite or other suitable material, containing a number of contact points, as at a, a, a, and from these contact points connecting wires are run off to every lamp whose use is to be registered. A double arm is mounted on a spindle, which runs through the center of the disk, and on each end of this arm is a platinum-tipped bearing piece, G, G.

These bearing pieces are adjusted so that they do not both bear upon contact points at the same time, but make contact alternately. The connections from the lamps are so made that when any contact point is touched by either bearing piece, the electro-magnet B is thrown into circuit with the corresponding lamp, and the escapement makes a click. This circuit is only complete when the lamp is lighted, and if any lamp is not in use, the corresponding contact point is out of circuit, and the contact of the bearing piece in that case fails to cause the current to flow through the electro magnet, and the escapement does not register. The connection which accomplishes this is simply a switch attached to the key of the lamp, and the mere turning on of a lamp throws it into circuit with the meter.

It is evident that if the arm carrying the bearing pieces is simply caused to revolve at a uniform rate, the system of registry will be complete. The means by which this is accomplished are not shown, but are readily understood. At first a thirty-day clock movement was used, in order that the instrument might not need attention oftener than once a month. As now made, a small and light-running, self-winding clock movement is attached, which automatically rewinds itself by throwing a little electric motor into action just before it is run down. This permits the use of light clock-work, and makes the apparatus small and inexpensive; besides which it requires no attention, but will continue to register indefinitely.

If the lamps to be used are all alike, each lamp is connected through but one contact point; but if not, the lamps of larger power are given sufficient number of connections to correspond for the increased current which they require. If a system contains both 8 and 16 candle power lamps, the 16 candle power lamps would be given two contacts for each single contact given to the smaller lamps.

Watchman's Clock and Fire Alarm Indicator.

The illustration in connection shows a combined watchman's electric time clock and fire alarm indicator, handled in the west by the Cen-

tral Electric company. In addition to recording the movements of the watchman, the dial also, through the medium of thermostats, records alarms of fire. The intent in the construction of this instrument is to thoroughly protect a building which it is set to guard, not only during the absence of the watchman, but during his hours of service when he may be detained in one part of the building and a fire may start in another part of the building. The clock cannot be opened unless the dial indicates the time of opening. It also has an attachment that will ring a bell in any desired place if the watchman should fall asleep or not commence his round within the prescribed time which is regulated by the clock. If the dial should stop its motion, the watchman cannot take advantage of it as the clock automatically sounds an alarm.

Interesting Motor Installation.

An interesting installation has been made in the gold and stock department of the Western Union Telegraph company, Chicago. The offices are located in the sixth floor of the Open Board of Trade building. From this point the grain and stock tickers in the brokers' offices throughout the city are manipulated. A visit to the offices is full of interest, as many ingenious devices have been designed to facilitate the transaction of business. Until recently the dynamos which furnished the currents for the tickers and for running a small Sprague motor, were located in the basement. They are Edison number 2 machines, and were driven by gas

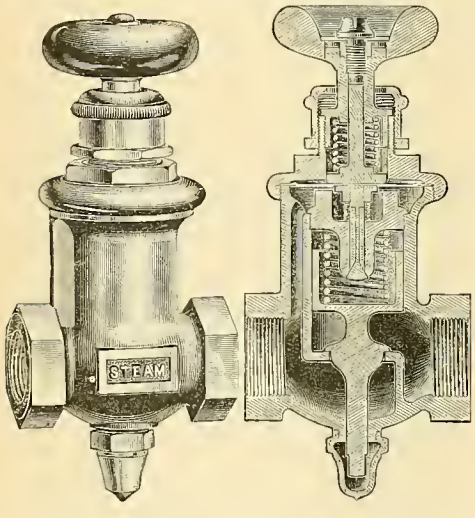
engines. Recently a radical change was decided upon which, it is thought, will greatly improve the efficiency of the plant.

Two of the dynamos were moved from the basement to the upper floor. They will be run by a 10 horse power Sprague motor which has just been installed. The motor receives its current from the Edison circuit. The use of the smaller motor will be discontinued, and the transmitters will be run from a shafting.

The Curtis Pressure Regulator.

The illustrations in connection show an improvement upon the Curtis pressure regulator for steam plants. The ordinary operation of the regulator is as follows: The sectional view shows a main valve operated by a loose fitting piston; a secondary valve in the top of the chamber over the piston; a metallic diaphragm, performing the double office of operating the secondary valve and making a joint to the cap which contains it, and a side passage, connecting the chamber under the diaphragm with the outlet. When the spring over the diaphragm is compressed the diaphragm gives way, and thus opens the secondary valve upon which it rests. Pressure being let on, raises the piston, and therewith the main valve, to its full capacity.

The main valve remains open until the back pressure communicated from the outlet through the side passage is sufficient to raise the dia-



phragm, and thus close the secondary valve, when the steam or water escaping around or through the loose fitting piston fills in the space on top of said piston and forces it toward its seat, thus uniformly maintaining the pressure at which it is set.

The improvement consists in threading the top collar or extension of the cap, which contains the regulator spring, outside as well as inside, and putting on to it a threaded sleeve, having a shoulder, which is adjustable, so that it can be set to stop the movement of the handle in one direction, while the extension of the top cap forms a stop in the other direction.

These valves are made with outlets from 1 to 1½ inches pipe thread to engage with different sized steam fittings, and are made and sold by the Curtis Regulator company of Boston, Mass.

New York Electric Club.

The New York Electric Club listened to a lecture by Dr. Moses Greeley Parker, of Lowell Mass., on the peculiar rotary motion found in lightning and other electric currents, Thursday evening, November 15th. Dr. J. M. Bleyer, who has just returned from Germany, where he assisted Dr. Morell Mackenzie last spring in his operations on the throat of the late Emperor Frederick, spoke of the plan for killing criminals by the death helmet charged with electricity. Dr. Bleyer said that the method would be most useful to science, and the helmet and recumbent position would insure instant death without suffering. He spoke of his experiment with a dog which he killed in one-sixteenth of a second by this process. C. J. H. Woodbury said that he thought electricity would be the best method of execution, although as to the helmet system he had not given it much attention. The general sentiment of the club was against its adoption.

A St. Louis paper says: Gentlemen are looking over the northern end of the city with a view to the establishment of an electric light plant.

Ohio State Tramway Association.

The seventh annual meeting of this association of street railway men was held at the Burnet house, Cincinnati, O., November 21st. Electricity, as a matter of course, received a share of attention. Among the papers on the development of motors the past year was one by A. G. Clark of Cincinnati, whose experience with electric railways commenced with the construction of the Baltimore & Hampden road in 1884. Mr. Clark knows of no plan of electric propulsion to be compared with the overhead system. "As electricians tell me," he says, "there has been but little advance over twenty years ago in the results produced by storage batteries, it is to be hoped we are approaching the time when some great discovery will be made which will make them applicable to all street cars, as there is no doubt this will be the perfection of street railroading."

Mr. Clark is interested in various street railways, and he is on the alert for the best system of operation. He has, moreover, had practical experience with several electric roads. He is thus enabled to speak with authority, and what he advises may well be taken as reliable. Here is what he says in regard to the construction of an electric railway: "In the first place, do not try cheap and inadequate construction; duplicate all your machinery and parts, and take the best care of your motors; cleanliness is essential to satisfactory operation; the motor drivers should be required to keep their motors free from oil and dirt, and everything that tends to this end should be provided for them; a pit should be conveniently located, so that frequent inspection may be made of the gearing."

As to trolleys, Mr. Clark advocates the under-running ones. And the motors he would have in the front part of the cars, except in case of heavy grades.

In course of the discussion that followed the reading of Mr. Clark's interesting paper, Dr. Everett of Cleveland said he had examined every mode of street car propulsion. He greatly admired the Bentley & Knight electric road at Pittsburgh, but he recommended to his directors the Sprague system which he had seen at Richmond. "They have adopted it, and we will be ready," said the doctor, "to operate eight miles of our road next month with the Sprague motors." C. B. Clegg, the millionaire of Dayton, congratulated Dr. Everett on his choice, and said, "So far as electricity is concerned, I do not think that you have made a mistake there."

Dr. Everett replied, "I adopted it, as I understood that no other system could use what they permit, the feed sys em of lines."

John A. Stewart, proprietor of the Ashtabula street railroad, announced the discovery of a "perfect" electric motor in his neighborhood. He prefaced his interesting statement with the remark that the country is full of electrical cranks, and that he was somewhat that way himself about a dozen years ago, and then said that, "At Ashtabula there is a young man who has invented an electrical system for the operation of street railroads, printing presses, sewing machines, etc. The electrical power is generated by the old system of Grove battery—that is, the blue vitriol battery These batteries to the number of seven I have seen in operation propelling a sewing machine. It is a make and break circuit. With a battery of 15 or 18 jars, weighing about 1,500 pounds, he generates electrical force giving a propelling capacity of about five horses. He has covered the ground pretty thoroughly, and he proposes to put this on a car at a cost of $1,200."

Later on in the proceedings Mr. Clark said: "There has been a reference here to five-horse power. In testing our road in Dayton, we found that the average amount of horse power was, in running a car on a level, from three to four horse power, electrical. If we were running around a curve on the level, we would exhaust from 12 to 13 horse power, and in going up a grade which we found on the engineer's plat to be 3.75 per cent., the horse power required was from ten to eleven, being less than going around a curve."

The Moral Effect of a Shock.

The London *Electrical Engineer* says: An incident happened last Saturday at Manchester which illustrates the moral effect of an electric shock. A certain Mr. Smith was discovered in a railway carriage senseless and ticketless. Being conveyed to the infirmary he recovered consciousness, but neither his ticket nor his power of speech. In fact, he declared in writing that he was both deaf and dumb. The doctors seem to have had strong doubts upon this point, and tried the application of electricity. The first shock Mr. Smith received from an induction coil not only enabled him to speak, but also to speak the truth. "My name is Smith," said he, "and you may put me down a rogue." "Great and many are the virtues of electricity," remarks the Manchester paper. "If certain politicians could only be compelled to make their speeches while in touch with a galvanic battery, we should evidently have more trustworthy history from them." The acumen of the doctors was applauded, and the value of electricity as a moral touchstone is now widely advocated.

Mr. Miller was present at a meeting of the finance committee of the city council at New Orleans, La., recently, in behalf of the bill of the Police Telephone & Signal company for putting up the patrol system, which was budgeted for in the reserved fund of 1887. Mr. Miller said he did not think the fact that no bids had been advertised for affected the contract. The city, he said, was in possession of the company's property, for which the latter is receiving no return. Appropriations out of the reserve fund under consideration had been made, but no appropriation has been made for the company which he was representing. The case had been taken to court by the committee of one hundred, but there had been no injunction issued with reference thereto. Mr. Miller was asked to furnish the committee with a statement of what really had been accomplished by the company, and promised to do so at an early date. The amount of the claim is $27,000.

CORRESPONDENCE

New York Notes.

NEW YORK, Nov 24.—After a prosperous existence of twenty-one years, the Telegraphers' Mutual Benefit association finds itself the oldest of the life insurance associations in the country based on the assessment plan. The fact that the single one which was older has gone out of existence during the past year points to the necessity of very careful management of such organizations. The annual meeting of the T. M. B. A. was held in the executive offices of the Western Union Telegraph company November 21st. About fifty delegates and members were present. The meeting was called to order at 4 P. M. by Vice-president W. H. Young of Washington, in the absence of President James Merrihew. The president's address was read by the secretary, and was most instructive in its dealing with the life insurance problem. The report of Secretary Bruch contained valuable statistics which were not read in detail, but it showed that while an increased death rate must now be expected by reason of the advancing age of the earlier members, it had been wisely provided for by the accumulation of a healthy reserve fund now amounting to about $70,000, and which was increased by the amount of $4,720 during the past year. There had been 282 new certificates granted during the year; 8 members had been restored, 11 applications rejected, and 7 members had withdrawn. The net gain of members during the year had been 164. There were 90 lapses and 33 deaths. The total membership is now 3,397. The second division now numbers 478 members, as the policies in the first division are limited to 1,000. Members requiring additional insurance in the association must join the second division, and it is desirable that the membership of the latter be increased. According to Treasurer Atkins' report the death claims paid were $15,000 in excess of the previous year. The reserve funds have been carefully invested in bonds of the Western Union and Gold and Stock Telegraph companies and Brooklyn mortgages. The election of officers passed off harmoniously, there being no opposition ticket in the field. President Merrihew, Vice-President Young, Secretary Bruch and Treasurer Atkins were all re-elected. The business of the evening having been disposed of early, the chairman called on the members and agents present for remarks as to how the interests of the association might be promoted. T. D. Lockwood's suggestion that its fields might be profitably extended to include telephone employes led to an announcement from the secretary that the executive committee had already established a rule covering that ground, which however, does not appear to be generally known. The sentiment of the meeting was that its membership should not be extended to other branches than the telegraph and telephone at present. After further remarks by Messrs. Dealy, Lloyd, Taitavall, Martin, Clark, Ives, Runyon, Tillinghast and others, the meeting adjourned at 6 P. M.

The extract in the New York notes of last week from the report of the Medico-Legal society's committee, as to the proper method of conducting an electrical execution, appears to have been substantially correct. It appears strange that a committee appointed for such important work should have made the deliberate statement that the "*larger* the surface of the electrode applied to the body, the greater will be the resistance." It appears that the whole thing has been improperly handled, and that there is a feeling of repugnance among electricians which prevents their taking a scientific interest in the question. The report is to be discussed at the meeting of the Medico-Legal society December 12th, and it is expected that some of our local electricians will be in attendance.

Progress in electrical traction is shown by the closing of another contract between the Julien Electric Traction company, and the Manhattan Elevated R. R. company for the equipment of the cars on the Grand Central branch of the Third Avenue line with electric motors. This is a short trip and but four cars are used, two of which will be equipped with motors having sufficient power to haul one car besides itself. The Sixth Avenue Horse R. R. company is also considering the advisability of substituting electricity for horses, and its decision will no doubt depend largely on the experience of the Fourth avenue line.

In Newark, N. J., and vicinity there is considerable agitation regarding the adoption of electricity for street railways. In South Orange the project has been killed for the present at least, by the action of the authorities. An ordinance was considered at the same meeting for placing telephone wires under ground. The Essex Passenger R. R. company has received permission from the Bloomfield township committee for the erection of poles and wires along its line to give the Daft company an opportunity to demonstrate the advantages of its system Corresponding authority was also received from the Newark common council to

erect poles on Bloomfield avenue. Thos. Wallace of New York also presented a petition to the council for permission to lay conduits in the streets for electric light wires. It was referred to the committee on public lighting.

The American District Telegraph company of Brooklyn, held its annual meeting in that city November 19th, and some interesting facts as to the work of the company were given in the official reports The police patrol of the company had, during the past year, found 2,000 houses insecurely fastened, 100 lights left burning after the occupants had retired; 650 police calls were answered, 36 disorderly servants ejected, and crowds dispersed, 51 drunkards removed, 19 arrests made on complaints of subscribers, 42 fire calls answered; officers were also assigned to special duty on numerous picnics, excursions, etc., 350 houses were watched during the summer by the day patrol and 225 guarded by special burglar alarms. P.

St. Louis, Mo.

St. Louis, Nov. 24.—Much of the credit for the victory in the telephone case, decided last week in Washington, is due to a St. Louis man, Hon. Jeff Chandler, general solicitor of the St. Louis, Arkansas & Texas railway Mr. Chandler was the first attorney employed by the government after the investigation by the Interior department as to whether the patent had been regularly granted or not, and has been a prominent figure in every phase of the litigation from its inception down to the time of the late decision by the Supreme court of the United States. "In order to break the force of the decision," said Mr. Chandler, "the attorneys for the Bell Telephone company and other persons interviewed in its behalf have industriously circulated the report that the decison only goes to the government's right to institute suit; that the salient and material issues are altogether unaffected by it. The decision, however, certainly does reach to the very foundations of the question, and practically and effectually settles all controverted matter. The fact is that the allegation of Professor Bell to the effect that the transmission of speech through his telephone is accomplished by causing electrical undulations in the line wire similar in form to the vibrations of the air accompanying vocal or other sounds, is extremely diaphanous, not a scintilla of proof having been introduced in support of that proposition. It is a scientific myth. Had the defendant declared that the method of transmitting speech was by electricity, the patent would have been void on its face, because of claiming an elementary principle as the chief subject of the invention. Therefore to avoid this, and to make it as occult and mysterious as possible, he puts his claim into meaningless and obscure phraseology. The matter has never before been thoroughly investigated, and the decision is practically a breaking down of one of the most powerful and grasping monopolies of modern times."

Gas will be exclusively used in all the departments of the federal building until January 15th. At that time it is expected the new electric plant, which is now being constructed at the building, shall have been completed. The insulation of the former wires was not perfect, and in consequence its light was poor. The arc lights suspended on the exterior of the building will be done away with, and incandescent lamps substituted in their stead, the light to be as intense as that of the arc lamps. Three large dynamos are being set up, and when everything is completed an inspector from Washington will arrive to see whether the light will prove satisfactory. Y.

Indianapolis, Ind.

Indianapolis, Ind., Nov. 22.—The McNeal Electric railroad will not be built for some time at least. At a meeting of the city council, Monday night, the ordinance granting it a franchise was repealed. Mr. McNeal says: "The repeal of the ordinance makes very little difference to us now, as we had decided to forfeit our franchise." The company had gone into the enterprise in good faith, but there were some changes absolutely necessary in the ordinance before it could begin work. He also says, when the company first made application for a franchise the Thomson-Houston company was the promoter. It was anxious to make a practical application of its new improved system, and considered Indianapolis a good point for such beginning Owing to the ordinance dragging along through the council so slowly, the company found an opening elsewhere. After this other eastern capital was interested, but under the conditions it was found impracticable to carry out their plans

The underground ordinance came up again in the council Monday night, and was amended and passed. As it stands now, any electric lighting company coming into the city must bury its wires—either arc or incandescent. This allows the Brush company to string its wires for extension on poles. It looks very much to an outsider as if this legislation was in the interest of the gas company, to keep out or hamper all possible competitors.

The Panhandle and Bee Line Railroad companies are fitting up handsome quarters in the new Union Railroad station, and will soon move their telegraph offices there.

Columbus, Ind , has completed a new fire alarm telegraph system, which is giving satisfaction. M.

Kansas City, Kan.

Kansas City, Kan., Nov. 23.—The question of lighting Kansas City, Kan., Wyandotte, Armstrong and Armourdale from a large central station has been a long-mooted question, and a great deal of effort, talk, plans and specifications as to how it could all be done, has been going on for nearly two years in this city. Numerous propositions have been made the city council during this time looking to the making of a city contract. Some months ago the city council formally granted a franchise to Benjamin Freidberg, and made with him a contract for lighting the main portion of the city by 100 arc lamps. After this was done Mr. Freidberg made a trip east to investigate the different systems of electric lighting, and take notes of the various kinds of engines, boilers and other machinery, with a view of selecting that which would secure to the city the very best apparatus in every detail. On his return he organized the Consolidated Electric Light & Power company with a capital of $100,000, with J. D. Wilson. of the First National Bank, as president; Mark Harris, vice-president; Benjamin Schnierle, secretary; F. C. Hutchings, attorney; Benjamin Freidberg, manager and treasurer. After the organization of the company, Charles Grover, formerly the Kansas City, Mo., agent of the Hawkeye Electric Light Manufacturing company of Oskaloosa, Ia , was elected superintendent and consulting electrician of the company. Mr. Grover then made a trip for still further investigation and information. After all these preliminaries were thus arranged specifications were sent out for bids for the furnishing of the apparatus. The contract for the engine has been let to the Hamilton-Corliss Engine company of Hamilton, O., for a 250 horse power engine The boiler contract was secured by the Babcock & Wilcox company of New York for a battery of three boilers, each of 92 horse power, making a total boiler capacity of 276 horse power. The site for the plant was selected at Riverview, and is now well under construction. The building is ample for the present and future needs of the company. A brick smoke-stack is now fast approaching completion, which will be 60 inches in diameter, and 100 feet high.

The pole line of the company will be about finished this week ready for the wire, and looks very straight and handsome. Thirty miles of wire are now in transit from the factory of the Electrical Supply company of Ansonia, Conn., the contract having been secured by that company's Kansas City, Mo., representative, Charles H. Cone. The board of directors has awarded the contract of furnishing the company 150 arc lamps and six 25 light dynamos to the Hawkeye Electric Light Manufacturing company of Davenport, Ia. Now that all the apparatus has been purchased, no possible effort will be spared to hasten to completion the work, and the company hope to begin operations and furnishing light by the 15th of December.

At the meeting of the common council of Kansas City, Kan., last week an ordinance was introduced by the Metropolitan Street Railway company asking a franchise to permit the erection of poles and electric wires along the line for the purpose of changing the motive power to electricity. The ordinance was referred to the proper committee. It is a well-known fact that the Metropolitan officials have spent considerable time lately in examining the different electric motor patents, with a view of securing the best for use on such suburban lines as it would not be practicable to change into cable lines. The ordinance does not specify the kind to be used, and in fact asks that either the conduit or pole system may be adopted. The Armourdale line extends from the stockyards to the southern bridge across the Kaw river at Argentine.

William Bowen, of the Hawkeye company of Oskaloosa, Ia., has secured the contract for putting in the plant of the Kansas City, Kan., Electric Light company. A.

Cincinnati, O.

Cincinnati, O., Nov. 22.—City Solicitor Horstman, before the board of public affairs, gave his opinion recently of the Cincinnati Inclined Plane Railway company's rights in the matter of an electric railway to Mount Auburn, which was to the effect that the company had already been granted permission to operate with electricity, and the only condition that the present board could impose on the company out of that grant was, that the system be of the latest and most approved kind. Further, that the thoroughfare shall not be obstructed. He was not ready to report on the claim of the company that it is operating under the steam railway act, and therefore exempt from car licenses, but would at an early day. The board then discussed the subject at some length, but were unable to come to a conclusion. The matter was finally referred to the committee on streets and grades; Messrs. Lewis and Whitfield, in connection with the engineer, who held a lengthy conference with the representatives of the company, and handed in a report which unanimously favors giving the company the right to proceed, but the poles were to be made of iron, and the rails to be used must be subject to the approval of the engineer. A wagon way of not less than eight feet must be left between the street curbs and outer rails of curves at McMillan, Corry, St. Clair and French streets. The streets torn up must be properly repaired and the tracks laid to the established grade. The board then unanimously adopted the report as read, and the railway representatives walked out with the permission to begin work at once. G.

Kansas Towns.

Topeka, Kan., Nov 23.—The North Topeka Electric Light & Power company filed its charter last week with the secretary of state. This is the fifth electric light and the third electric power company organized in this city. The others are all in active operation except the Rapid Transit company's electric power plant, which is now being constructed. The capital stock of the North Topeka Electric Light & Power company is $25,000. The directors and officers are among the best known business and professional men of the city. The following are the directors: H. C. Safford, James Riley, J. M. Smith, W. C. Knox and W. M. Rynerson. The officers are H. C. Safford, president; James Riley, vice-president; W. M. Rynerson, secretary, and W. C. Knox, treasurer. This company has been contemplated for some time. It has purchased a site with suitable buildings on Laurent street, between Kansas avenue and Jackson street, for $4,500, and work will be begun erecting wire and putting in machinery immediately. The Jenney electric system now operated by the city will be used. The company will confine its incandescent service to that portion of the city north of the river, but will compete with other companies with its arc service south of the river. James Riley, superintendent of the city electric light service, is one of the directors of the new company and the heaviest stockholder. He is one of the best electricians in the country, and, having charge of the mechanical department of the new company, he will make it one of the most efficient companies in the city. The new institution has a good field in which to operate, and is assured of ample support from the start. G.

Anthony, Kan., Nov. 26.—The city council has granted a franchise to the Thomson-Houston Electric Light company for the establishment of an electric light plant here. E.

Kansas City, Kan., Nov. 24.—Charles Grover, manager of the electric light plant here, announces that the work on the buildings and the stringing of the wires is being pushed as rapidly as possible, and that not a moment will be lost in getting the plant ready for operation. R.

Wichita, Kan.

Wichita, Kan., Nov. 17.—Tuesday last a delegation from the board of trade, the city council, and the press of the city took a ride over the Riverside and Suburban electric railway on the invitation of the company to witness the successful operation of the road. Another system was tried at the outset several months back, but proved to be a failure; but the projectors nothing daunted, made a contract with the Thomson-Houston Electric company for the present system. At 10 o'clock the road was declared in readiness, and the first electric car came rapidly down Market street at the appointed time. Two cars were immediately loaded to their utmost capacity and started off as easily and naturally as if the road had been in operation for months. It was a novel sensation to be drawn through the streets in a nicely appointed car by an invisible force. The power house was soon reached, where the entire party alighted to look at the machinery. The works were constructed and the roads at present operated by Edward Verstraete, an electrician with the Thomson-Houston Electric company. The engine is a Smith, Beggs & Rankin of St. Louis, of 80 horse power.

Each car has three incandescent lights inside, and another light is placed over each platform. Otherwise the interior of the car resembles any ordinary tram car. The action of the switches is so perfect that the car can move so slowly as to be scarcely perceptible, or it can obtain a speed of twenty miles an hour. It stops readily within its own length, or in cases of emergency by reversing the power, it can be stopped instantly. It backs, stops and starts with a facility that is reassuring, and before long the mule will be a motive power of the past in street travel. The cost of running a car line by electricity is estimated to be about 60 per

cent. of that required in using mules or horses. Mr. Davidson was present and was a recipient of congratulations on every hand at the ultimate success of the road in which he is the leading stockholder. N.

Kansas City, Mo.

KANSAS CITY, Mo., November 24.—An attachment was issued by Judge Field in the Circuit court last week for Manager M. D. Wood of the Western Union Telegraph company, for contempt of court in refusing to produce certain papers affecting the suit of Telegraph Operator Edward L Randall against the Rock Island railroad. The trial of the case was begun but was postponed until the January term, and the question as to whether Mr. Wood will be compelled to produce the documents in question will be argued Saturday Randall was a telegraph operator in the employ of the Rock Island railroad company, and was stationed at Davenport, Ia. In his petition, he says he was discharged more than a year ago, because he was an organizer and the vice-president of the Order of Railway Telegraphers, which made him especially obnoxious in the eyes of the railway company and the Western Union Not only was he discharged, Randall avers, but he was placed on the black list and thereby prevented from earning a living at his vocation, for which he asks $25,000 damages. It seems that the black-listing of which he complains, is a system by which superintendents of telegraphy throughout the country are notified of the discharge of any operator and the cause for his dismissal, and Randall claims that it debars the man black-listed from again securing employment; but the telegraph and railway officials deny this, saying that it aids superintendents in learning the character of the men they employ. Circulars giving the lists of the employes discharged are distributed among the telegraph company's managers. Manager Wood received one of these, it is claimed, and this is the document which he declined to produce in court. Randall claims that the cause for his discharge given in the list was that he was an organizer in the Order of Railway Telegraphers. Mr. Wood refused to produce the papers in the taking of a deposition last April, but Randall's attorney, Col. John W. Wofford, did not insist on it then. Since then he has been advised not to surrender the papers, inasmuch as the Western Union is not a party to the suit. The defence of the Rock Island company is, that the company has the right to discharge its employes and to say to any of its superintendents why they are discharged. The deposition of Asa R Swift, superintendent of telegraphy of the Rock Island, was read in court. Mr Swift says that he talked to Randall about his connection with the order, and the latter denied that he was an organizer. He afterward admitted that he was, and Mr. Swift states that he regards this as sufficient grounds for dismissal. Judge E. H. Stiles, one of the attorneys for the Rock Island, said that the defence had no objection to Mr. Wood producing the circular in court.

The secretary of state has issued a certificate of incorporation to the Kansas City & Blue Valley Railway company, organized to construct and operate a line of standard gauge railroad from the intersection of Blue avenue and Kensington street to the western limits of the city of Independence. The incorporators are Dr. Morrison Munford, Thomas J. Green, L. E. Davison, E. M. Holmes and A D. Leech. They propose to use electricity as the motive power if they find it practicable.

William J. Clark, special agent of Thomson-Houston Electric company, railway department, is at the Midland hotel. Mr. Clark thinks he will secure the contract for running the cars on the Metropolitan electrical railway extension to Armourdale.

The Inter-State Electric Light company has its entire plant in operation now. About 500 incandescent lights are supplied directly from the central station. One hundred and twenty cells are on this circuit, which is supplied by a Fort Wayne Jenney dynamo. The sub-stations are supplied by the new dynamo of 50,000 watts capacity, made specially for this plant by the Detroit Electrical works.

About 1,200 lights are furnished from these sub stations and the company is kept constantly behind in supplying orders. Superintendent Bossart states that the Inter-State company has the largest and finest accumulator system plant in the west. A.

Little Rock, Ark.

LITTLE ROCK, Ark., Nov. 21.—The last act in telephone competition, at this point at least, was performed Tuesday afternoon of last week. Special Agent Frank B. Knight of the Bell Telephone company had a big bonfire, consigning to the flames all the telephones, bells and apparatus formerly used by the Southern Telephone company. On the first of the month a decree was rendered in the United States Circuit court in favor of the Bell company, turning over all the infringing instruments to it, and these were the ones burned. There were about 425 complete sets, and a lot of different styles and parts of microphones. In all, about 1,200 telephones, representing a cost of at least $20,000, were consumed. The wires, poles, and all the rest of the plant have been bought by the Erie company, and it is now busy taking most of it down.

The Edison Electric Light & Power company has now about 1,200 lamps burning. They are giving a splendid light, and have a large number of orders yet to fill. This company lights the Capital theater, and a recent performance of "Faust" was wonderfully assisted by the sudden changes from light to darkness made possible by electricity. All theater-goers are loud in their praise of the beautiful effects produced, and brilliant appearance of the house, as now lighted. The company is preparing already for a large increase in its plant, and is about to wire the residence portion of the city. It expects to have at least 3,000 lights burning very soon.

The Little Rock Electric Light company is now furnishing incandescent lights as well as arc. It uses the Westinghouse alternating system. It furnishes 16 candle power lights until 12 P. M. at 80 cents, while the Edison ask $1 for 20 candle power until 1 A. M., and $1.50 for all-night lights.

With the city plant of over 100 arc lights, and the private lights of the other two companies, Little Rock is a very well lighted city. The lights on the towers, over 130 feet high, form a very pretty sight dark nights, seeming to be suspended without any visible support. The three lamps on each tower glow like triple stars. There have been two or three dark rainy nights when they failed to glow, and then the belated ones who stumbled along were anything but complimentary in their remarks. Residents are not particularly in favor of a moonlight schedule. Cloudy nights when they should have moonlight, according to the almanac, they have only darkness. The first wet night after the station was started an electric light wire crossed with a telephone wire, set fire to the cupola of the exchange, and burned out over 400 wires, demoralizing the service for several weeks, until new cables, lightning arresters and transfer boards could be gotten in. The exchange now has safety fuses on all wires, and feels somewhat safer. A.

Omaha, Neb.

OMAHA, Neb., Nov. 23.—The Nebraska Electrical Light & Motor company of Omaha has filed articles of incorporation with the secretary of state; capital stock, $500,000; object, to manufacture, sell and own electrical motors and electrical lights, and all kinds of electrical apparatus; incorporators, D. B. Covell, W. S. Marr, Jeff W. Bedford, T. S. Clarkson, J. J. Mills, Oliver T. Briggs and H. Walker. R.

Alabama Projects.

ANNISTON, Ala., Nov 22.—Mobile, Ala., has adopted the Gamewell fire alarm system, and it is ready to be put in operation after being formally tested by the city authorities, which is to be done in a few days.

Eufaula, Ala., is figuring on the cost of an electric light plant. The Thomson-Houston company agrees to put down fifteen 2 000 candle power arc lamps for street lighting at $1,250 per annum, and incandescent lamps for private consumers at their usual rates.

The Thomson-Houston company is to put in an 80 light plant at the new Ensley furnaces, near Birmingham, Ala., which, it is claimed, are the largest in the world.

The installation of an arc light plant is under consideration by the Woodstock Iron company at the new coke furnaces now erecting at Anniston, Ala. R.

TUSCALOOSA, Ala., Nov. 22.—D. F. Torbett will erect an electric light plant here for both arc and incandescent lighting. M.

Iowa Items.

DES MOINES, Ia., Nov. 23.—The contract for putting electric wires in the High School building has been let to Canady & Leckey, who have been wiremen for the Edison company for several years, but are now in business for themselves over 125 Fifth street, Des Moines, Ia. N.

COUNCIL BLUFFS, Ia., Nov. 28.—Manager Evans of the Bridge company says that the electric motor line will not be in operation before December 1st. The reason given is that there is still a great deal of work to be done on the line before it will be ready for regular trains. There is also a good deal of work to be done in the power house. Another dynamo will have to be put in. Some other machinery is yet to be received. Mr. Evans is of the opinion that the builders of the line will be doing well if they have it ready to turn over to the company by the first of December. E.

THE ELECTRIC LIGHT.

Big Rapids, Mich., has let a contract for lighting the streets by electricity.

Laurens, S. C., is discussing the advisability of introducing the electric light.

The incandescent electric light plant will be in operation in Keokuk, Ia., within two weeks.

The citizens of Cambridge, Md., are contemplating having the town lighted with electricity.

The Western Electric company, Chicago, has sold to the Eagle mills, at Eagle Mills, Mich , a 12 light arc plant.

Wheeler & Tappan of Chicago have purchased of the Western Electric company, Chicago, a 12 light arc plant.

The Wilmington, N. C., City Electric company is putting in a 200-horse power engine, and dynamos for 2,500 lights.

The Griffin, Ga., Light & Water company, capital stock of $25,000, has been formed to erect an electric light plant,

Marshall Field & Co., Chicago, have purchased of the Western Electric company a 25 light arc plant for their retail department.

A note going the rounds of the press says that Noah must have had ark lights, so that electric lighting is not a modern invention.

The Thomson-Houston Electric company has presented two dynamos to the electrical engineering department of Cornell University.

Pierce Brothers have been granted a 15-year franchise to establish a system of electric lights in Austin, Minn. The work will begin at once.

The Western Electric company of Chicago will install a 25 arc light plant in the factory of the Haxtun Steam Heater company, Kewanee, Ill.

The Westinghouse Electric company has just closed a contract with the city authorities of Hamilton, Ohio, to establish an electric light plant in that city.

The capacity of the Edison electric light station in Sioux Falls, Dak., has been increased to 1,500 lights. The electric light plant represents an outlay of $75,000.

Additional machinery is being placed in position at the works of the Birmingham, Ala., Gas Illuminating company. The capacity of the incandescent light plant will be increased.

The Brush Electric Light & Power company, Montgomery, Ala., who have been enlarging their building to increase the capacity of the plant, are adding machinery for incandescent lighting.

A part of the machinery for the electric light plant at South Omaha, Neb , has arrived. Work on putting up the poles is progressing rapidly; and the light will be in operation in about three weeks.

The electric lighting of the Hoosac Tunnel, Massachusetts, is now nearly completed. Very large cables have been laid through the tunnel for a distance of about five miles, and the electric lights will be placed about twenty feet apart.

Minneapolis capitalists have been at Huron, Dak., negotiating for the purchase of ten acres adjoining the city on which to build cottages for rental. They will be furnished with artesian well water, lighted with electricity, and heated by steam.

The city council of Bangor, Me., is considering the advisability of purchasing an electric light plant of 120 arc lights. The city officials secured the services of Fred. H. Whipple to advise them in the matter of locating and purchasing a plant.

The Willamette Falls, Ore., Electric company has been incorporated with a capital stock of $1,000,000. The incorporators are D. P. Thompson, E. L. Eastham, P. T. Morey, R. H. Thompson, L. L. Hawkins, W. K. Smith and J. C. Moreland.

The station to be built at Stowage wharf, Deptford, by the London Electric Supply corporation is sufficient for the supply of 250,000 incandescent lamps, and there is space for three other sets similar to the first, giving a final capacity of 1,000,000 lamps.

The electric light station at Mahanoy City, Pa., was totally destroyed by fire November 10th. The dynamos and the engines were ruined, and the loss will amount to $15,000 or $20,000, partially covered by insurance. The cause of the fire is unknown.

The Jenney Electric company of Indianapolis, Ind., is installing an electric light plant in Jackson, Miss., for street lighting. In mentioning this installation in the issue of November 17th, the company's headquarters were erroneously stated to be in Fort Wayne.

A. L. Dutton of Racine, Wis., has invented a submarine search light with photographic attachment. It is so arranged that a wreck under water can be brilliantly illuminated by an incandescent light, and at the same time an accurate photograph taken of the surroundings.

The Kenosha Gas, Electric Light & Fuel company is the title under which the old Kenosha, Wis , Gas Light company is to operate hereafter. The capital is placed at $50,000, and J. H. and E. M. Kimball and Edgar G. Hazelton are still the prime movers of the enterprise.

A dispatch from Columbia, Ga., says: The electric light has now been tested in Columbia for four nights, and everybody is delighted with it. Many business houses on Main street are adopting it, and so many applications for lights are being made that the electric light company, with its present plant, is unable to fill all of them. The company has two dynamos employed, with a capacity of thirty

arc lights each. They will probably order next week a third dynamo, and fifteen of its thirty arc lights have already been engaged. In addition an incandescent machine will be ordered, and this light will also be extensively used.

The county commissioners at Denver, Col., have instructed the chairman to accept the proposition of the Denver Light, Heat & Power company to light with incandescent lights the clerk and treasurer's offices, the basement vaults and the main halls of the county buildings

The Heisler Electric Light company of St. Louis, Mo., has shipped a large order to Buenos Ayres, South America, and has also received an order from Kingston, Pa. The latter plant will include street, commercial and private house lighting, and will have eight or ten miles of circuits.

A Pittsburgh paper says: The Westinghouse Electric company having secured the Waterhouse arc light system will commence work on a plant for the manufacture of the new lights almost immediately, and it is expected that about 200 men will be employed in that branch of the electric business.

The city council of Elgin, Ill., proposes to satisfy the demand of the citizens for additional electric lights for street illumination. The streets have been lighted by 30 arc lights owned by a private individual. The council now proposes to purchase a plant outright. The mayor and several of the aldermen were in Chicago last week investigating the merits of the several systems.

C. C. Haskins, inspector of electric lights in Chicago, occasionally makes queer discoveries. While testing a plant one day last week he came across a joint in an incandescent wire decked out with patriotic colors. Inquiry developed the fact that the attendant had not considered the insulation at that point sufficient, and accordingly he had secured some common parti-colored cotton tape, and had carefully wound it about the joint.

An iron hook saved the life of Electrician Charles H. Borden of Philadelphia, November 13th. He was supplying fresh carbons for electric light poles, when his foot slipped and he was precipitated toward the pavement. In falling one of the iron foot-rests caught his thigh, and tearing deep into the flesh, held Borden suspended in mid-air. His cries brought Officers Mason and Quick to his assistance, and they raised a ladder and rescued him.

An English paper tells this story: A young masher was being shown over the installation in the city at the time of the old Metropolitan Brush company, and while the engineer's back was turned the visitor rolled a cigarette and tried to light it at an arc lamp. There was a slight "earth" and the current came down the moistened cigarette to that young man's molars, and he had sufficient toothache to last a good many lifetimes during the next minute or two.

One of the schemes that has been evolved in Milwaukee is to have the municipality put in an immense electric plant so as to provide that kind of illumination for every one of the eighteen wards. The argument used in support of the plan is that if the city furnishes water to its inhabitants, it ought also to furnish light without having to furnish it from an outside corporation. Nobody has as yet made any estimate as to the amount that would be required for such a plant.

The Red Wing Gas & Electric Light company of Red Wing, Minn., has closed a contract with the Northwestern Construction & Supply company of St. Paul for a complete refurnishing of the electric light station in Red Wing. The refurnishing will include the introduction of the Westinghouse alternating system, and the complete remodeling of the present plant. New wires will be strung for the street and store lighting, and larger and heavier poles erected.

The plant of the Macon Ga., Gas Light & Water company is now in successful operation, and Macon will be furnished an electric light that will be a success in every particular. This new plant represents an investment of about $50,000. The plant is situated at the works of the gas company near the foot of Mulberry street. There are 500 incandescent and thirty-five arc lights, operated by an engine of 100 horse power on which thirty-five more arc or 350 incandescent lights can be placed as the demand for them requires. The arc sheds a light of 2,000 candle power, and the incandescent has twenty candle power.

Whenever a Hartford policeman discovers an electric light on his beat to be extinguished he makes a memorandum of the location of the light, and the time when it ceased burning. This memorandum he puts upon a postal card, which he mails to the street board. Often the time when the lamp is relighted is not given, and the street board cannot tell how much time to charge against the electric light company. The board has, however, adopted a rule that whenever a light is reported out an hour shall be deducted from the service as charged by the electric light company. When a light is reported two or three consecutive nights as out, the company is required to replace it.

The electric light company at Fergus Falls, Dak., have decided to move their plant from its present location to the lower dam, midway between the knitting mill and the woolen mill. Mr. Erwin, president of the company, gave the following reasons for so doing: "By having our plant run by water power, we will be able to give a more even light, and better satisfaction to our patrons, and in case we desire to continue the circuit all night, it will be less trouble with water power than by steam. Building operations will be commenced at once, and the shaft will be made about December 1st. We will lease power from the water power company and put in our own wheel. The building will be of frame construction, sheathed with sheet iron, to make it fireproof, and will be about the same size as the present one."

THE ELECTRIC MOTOR.

An electric road is to be constructed at Elkhart, Ind.

The Erie Electric Motor company of Erie, Pa., has been incorporated The capital stock is $400,000.

At the meeting of the Buffalo common council the petition of the People's Electric Railway company to lay tracks on certain streets came up for consideration, but action was postponed

The electric railway at Lynn is expected to be in operation within a week or ten days. The current will be supplied by the Lynn Gas & Electric Light company.

In all probability a storage battery road will be constructed at Dubuque, Ia. A public meeting was held to consider the matter November 13th. Nearly enough stock was subscribed for at that time to insure the building of the road.

The Electric Light company at Newburyport, Mass., has received the commission from the Horse Railroad company to erect poles for the equipment for the Merrimac branch with electricity. It is the intention to have the Newburyport and Amesbury line running by electricity before next July.

The electric railway at Fort Worth, Tex., will cost $35,000 to $40,000, and is to be laid with thirty-five pound rails outside of the city. It is expected that the cars will be run to the union depot, and as the Main street line is controlled in greater part by those interested in the north town properties this extension is probable. The road, together with 717 acres of land, was recently purchased by a syndicate headed by Irving Evans and Walter Petter of Boston, and J. V. Farwell of Chicago.

The electric cars for the London North Metropolitan tramway are now in an advanced state of preparation. The motors are ready, and 600 double cells have been ordered. It is generally expected that the arrangements will be in practical working order by Christmas, and that the line will be handed over to the Electric Traction company to run by stored electricity, instead of horses, by the beginning of the new year. Many tramway companies are waiting the result of this trial, and the favorable certificate of the North Metropolitan would result, without doubt, in a very general adoption of electric traction in English tramways.

The Decatur, Ill., *Herald* says: E. J. Martin, special agent for the Sprague Motor company, offered $38,000 for the Decatur Street railway and equipments. The offer was declined without thanks, as the stockholders of the Citizens' line believe that the value is at least twice the amount offered. Mr. Martin says that the people of Decatur will shortly be surprised with a new street railroad with electric motor power. Mr. Martin finds encouragement in securing right of way, and believes that he will have a new route to lay before the council soon. He declares that it is impossible to offer for the present street railway system any greater sum than it is worth to a company using electric motors. He says that there is no disposition to play a bluff game, but that competition in every branch of trade is a good thing. The men who believe that an electric street railway can be made to pay here are willing to back their opinion with money. The *Herald* can only reiterate its previous statement, that if a syndicate of eastern capitalists want to invest $50,000 in Decatur, they ought to have the chance to do it.

The following paragraph is taken from the Richmond *Dispatch:* One of our exchanges has a paragraph stating that the electric storage system is not only a success so far as experience shows in relation to street railways, but that the Omnibus company of Paris runs carriages by electricity from the Arc de Triomphe to Carbevoie, a distance of two miles. Each of the fore wheels, our contemporary says, is moved by a separate dynamo, controlled by the driver. The speed attained is somewhat greater than that of horse propulsion, and the general operation satisfactory. All carriages will be moved in the same manner before many years shall have passed over our heads—that is, by electricity. This is the motive power of the future. If this power can be stored and carried about as cheaply as it would seem it can be, there is no reason that we can think of why it cannot be substituted for horses in moving wagons, carts, drays and what not. Rapidity of motion will be one feature of the wagons and other carriages of the next generation. The words of Nahum may soon be fulfilled predictions: "The chariots shall rage in the streets; they shall jostle one against another in the broad ways; they shall seem like torches; they shall run like the lightnings." This is not a bad description of the electric cars as these appear at night.

From time to time electric traction makes its appearance on the Paris tramways, but vanishes again after a brief spell of apparent success, for some reason not easily ascertained, says *Industries*. The latest development of electric tramway work is an experiment which is being carried out on the line between Porte Maillot and the Barriere de l'Etoile by means of storage battery cars, which are very handsomely fitted up, and which have now been running for nearly two months. The battery is of the Faure-Sellon-Volckmar type, constructed by Philippart Freres, and consists of 144 cells, which, by means of a special switch, can be grouped in various ways so as to supply the current under different pressures, viz., 70, 140, 240 and 280 volts. The total weight of the car with fifty passengers on board is close upon 9½ tons, and the normal power required when running on the level, and at ordinary tramway speed, is 7 horse power; but when starting and when climbing gradients the battery is often called upon to deliver current at the rate of 20 horse power. The total capacity of the battery is 42 horse power-hours, so that the car can remain from five to six hours in service before having to be recharged The usual provision is made for charging batteries with the least possible loss of time. The motor is a Siemens dynamo placed under the car floor, and running at 1,000 to 1,200 revolutions per minute. The car is lighted from glow lamps fed from the batteries.

The Pittsburgh, Allegheny & Manchester Street Railway company of Pittsburgh, Pa., will probably introduce the electric system. A committee has been engaged in investigating the several systems. Some prefer the storage batteries and others the overhead wire system. One of the officers said recently: "I am in favor of electricity, with overhead wires, and if stockholders owning 600 shares will support me, that system will be adopted. There may be some difficulty in getting the privilege of erecting poles along the route."

THE TELEPHONE.

A fight is to be instituted in Rochester, N. Y., against advertisers who tack placards on telephone poles.

A special section of the Paris congress is to be devoted to telephony. An attempt is to be made, on the French initiative, to organize an international telephone exchange.

"Fifty cents, please," said the hotel clerk to the lady who had been using the telephone. "I thought the charge was only 10," she replied. "Yes," he returned, "but that is the rate for men, you know."—*Judge.*

The Bell Telephone company recently began suits against several of its former subscribers in Rochester, N. Y. They did not renew the contracts after the adjustment of the controversy between the citizens and the company, and the actions are instituted to recover on the old agreements with the corporation.

At a recent meeting of the Houston, Tex., city council, an ordinance was passed granting the Erie Telegraph & Telephone company the right to erect poles within the city, the same to be thirty-five feet from the ground to the lowest arm of the poles in all places within the fire limits, and twenty five feet in outside places.

A dispatch dated November 23d, from Dixon, Ill., says: Thomas M. Gaffney committed suicide at his home in this city last night by shooting himself through the head. Death resulted in about an hour. He was for many years manager of the Western Union Telegraph company, and also of the telephone company. He was a prominent dealer on the Board of Trade.

The city authorities of Burlington, Ia., and the Iowa Union Telephone company have been engaged in a controversy. The city council refused to pay its bills for instruments, and ordered poles removed from the streets unless the telephone company would make concessions in the way of furnishing poles for fire alarm wires. It is expected that a compromise will be reached.

A New York prophet says the telephone of 1900 ought not to cost more than a dollar, and telephone service in that year ought not to cost more than $5 a year, to put it at an extravagantly high figure. Telephones, he says, will become as essential to a properly furnished house as gas and water are now, and they will be used for house service instead of speaking tubes and door bells.

The new cables for the use of the telephone company have arrived, and are being placed in position, says a Council Bluffs paper. The interior of the telephone exchange is being enlarged and remodeled, and when completed Manager Lane will have the finest office belonging to the Iowa & Nebraska Telephone company. As soon as the changes now under way are completed this city will have the finest service in this part of the country.

The Supreme court in general term, in New York city, decided, November 2d, that the Bell Telephone company of Boston is liable to taxation in New York. The state claimed the right to collect a tax of ½ per cent. on the gross earnings of the company, and suit was brought to recover taxes for the years of 1882 to 1886. The defense was that the company's capital was not employed here, and that it did business only through the local corporations. The court holds that the company was not liable under the statutes until 1885.

The following dispatch, dated November 23d, was sent from West Superior, Wis.: The American Bell Telephone company purchased yesterday the entire plant of the Superior Telephone company for $35,000, and has commenced the work of placing the system in condition for operation This settles the telephone war which has been going on for the last year. The Superior Telephone company had been using instruments manufactured by the Cushman Telephone company of Chicago, but were obliged to remove them as the results of a lawsuit instituted by the Bell company for infringement.

THE TELEGRAPH.

The case of Feigles against the Western Union Telegraph company, at Fort Worth, Tex., ended in a $1,500 verdict for the plaintiff. He sent a telegram from Malvern, and it was not delivered.

A new scheme of card telegrams is being tried in Hungary for use in districts having a postoffice, but without a telegraphic service, says the London *Electrical Review*. Cards are sold at the postoffice at the price of 35 kreutzer for five words, excess to be paid for by additional postage stamps, to be affixed at the corner. The telegram can be put in any letter box, and is forwarded to the nearest telegraph office, and from there it is dispatched without further delay or charge. It is not so generally known to the public as it might be that in England telegrams can be posted at any pillar box, and will be sent on from the nearest telegraph office. Some such scheme of special forms for this purpose, in the shape of card telegrams, might render this of greater practical utility, and the example of Hungary is worthy of the attention of the postoffice authorities.

Personal Paragraphs.

George T. Manson of the Okonite company, New York, was in Chicago last week.

N. S. Possons of the Brush Electric company read a paper on "Recent Applications of Electricity" before the Cleveland Civil Engineers' club November 13th.

John. I. Sabin of San Francisco, general superintendent of the Pacific Bell Telephone company, and general manager of the California Electrical works, was in Chicago November 21st. After a brief stay he left for an eastern trip.

W. K. Freeman, manager of the National Electric Manufacturing company of Eau Claire, Wis., passed through the city Monday on his way east. Mr. Freeman's company, besides manufacturing electric lights, will draw and cover wire for electrical purposes, and part of his mission east is to purchase the requisite machinery for this branch of their business.

Business Mention.

The Electrical Construction company, Chicago, has received the contract for wiring the newly-finished part of the court house, Chicago.

An order has been made requiring all road engineers of the Northwestern railroad to have their watches protected by anti-magnetic shields

The Southern District Telegraph & Electric company of Birmingham, Ala., has added a nickel plating department to its business. A system of electric time will also be introduced.

W. N. Gray of Cincinnati, O., has recently made the following sales: Seventy-five light Mather plant to Geo. H. Bonte, Cincinnati, O.; seventy-five light Mather plant to the Beckett Paper company, Hamilton, O.; two 150 light Mather dynamos; 600 light Mather plant to Kentucky Wagon company, Louisville, Ky.; thirty-five light Waterhouse plant to Weir Frog company, Cincinnati, O.

The Hill Clutch works of Cleveland, O., have recently established a branch office at 1221 Union avenue, Kansas City, Mo., under the management of A. M. Morse. The Hill Clutch works find business looking very bright for them in the west, and they have just made contracts for complete outfits of power transmission machinery for the Thomson Houston electric light plant at Topeka, Kan., and for a plant at Kansas City.

The National Electric Manufacturing company of Eau Claire, Wis., has installed its first dynamo in the Pioneer Furniture factory in that city. The new generator works admirably in every particular. The Eau Claire *Daily Leader* says of the installation: "In the evening several interested parties visited the Pioneer Furniture factory, and found the same brilliantly illuminated with the new light. They all agreed that the light was perfect and the manner of illumination left nothing to be desired. The dynamo is, we must say, the most symmetrical and well-proportioned piece of machinery we have ever seen in the way of electrical apparatus. The pattern is graceful and light, and at the same time solid and substantial enough to run at the necessary speed without the least vibration or noise."

During the past few years the Western Electric company has been making special effort to bring the Leclanche Battery to the highest degree of perfection attainable. That the endeavor has not been fruitless is attested by the fine trade in this battery which the company has secured. An improvement just introduced seems worthy of particular mention. It has been customary thus far to have vent holes in the wax at the top of the porous cup. In some cases these holes have been left rough and in others glass funnels have been inserted. The Western Electric company has used funnels The improvement consists in closing the top of the porous cup perfectly tight, and making the vents in the sides of the cup at about the water line. The advantage gained by this change is that the climbing salts have no passage through the wax, and the vapors rising from within the cup are kept farther away from the head of the carbon plate. In practice, so far, climbing salts do not rise above the holes in the sides of the cup.

Electrical Patents.

Issued November 20, 1888.

393,012. Metallic Connector for Electric Railways. Joshua Kames, Philadelphia, Pa.

393,013. Conduit for Electric Conductors. Joshua Kames, Philadelphia, Pa.

393,040. Electric Light Pole. Elihu Thomson, Lynn, Mass.

393,072. Electrical Apparatus for Preventing Corrosion of Steam Boilers. Augustus J Marquand, Cardiff, County of Glamorgan, England.

393,073. Transformation and Distribution of Electrical Energy. William J. McElroy, Pittsburg, Pa., and Thomas J. McTighe, New York, N. Y.

The invention relates to the transformation and distribution of electrical energy, and has reference especially to a system of distribution from high potential on the main or distributing line to currents of low potential in the consumption circuits or lines.

The claim reads: "In a system of transformation or conversion of electrical energy, the combination of an alternating current generator, a pair of mains respectively connected to the terminals thereof, two electrostatic converters, and consumption devices, said converters being composed each of two members of different area, the smaller members being respectively joined to said mains and the larger members connected to said consumption devices."

393,078. Electric Alarm System. William F. Rossbach, Brooklyn, N. Y.

393,088. Instrument for Measuring Electric Currents. Addison G. Waterhouse, Hartford, Conn.

The object of the invention is to produce an instrument which will be sensitive to variations of the current transmitted through it, and which will invariably indicate such changes at all times and under all conditions.

The third claim is given: "The combination of a series of key levers turning upon a fulcrum rod, a rocking plate turning on said fulcrum rod and arranged above all of said keys and having a laterally extending arm and a T shaped cam provided with an ear resting upon said arm."

393,123. Galvanic Battery. Francis H. Root, Chicago, Ill.

The invention consists in providing in a battery cell a chloride of silver electrode and a zinc electrode, the former constituting the negative and the latter the positive element. These electrodes are immersed in an exciting medium consisting of a gelatine solution charged with muriate of ammonia, and reduced to about the consistency of a thick paste.

The second and sixth claims are given: "2. The combination, in a galvanic cell, of zinc and chloride of silver electrodes, a porous cup intervening between the two electrodes, and an exciting medium consisting of a gelatine solution charged with muriate of ammonia and reduced to the consistency of paste, said electrodes and porous cup being all immersed in said thickened exciting medium.

"6. In a battery cell, a perforated cylindric zinc electrode combined with a thickened exciting medium."

393,125. Apparatus for Removing Frictional Electricity from Machinery. William Schulte, Apollo, Pa.

The invention comprises electrical conductors applied to the constituent members of a plant of machinery and arranged in as many circuits as there are individual members of the plant combined with a switch-board and ground connections for both the machinery and the electrical conductors.

393,132. Electric Meter. Frank C. Wagner, Ann Arbor, Mich.

393,146. Mechanism for Changing Electric Circuits. Henry Edmunds, London, Eng.

The invention employs a closed hollow cylinder or drum divided into compartments by partitions radiating from the axis of the cylinder or drum, there being small openings through the partitions, so that liquid in one compartment can flow slowly into the next, and find its level. This drum is mounted on a shaft driven by a suitable motor—such as a spring or weight—the liquid in the drum serving to regulate the speed at which the shaft rotates The spring or weight is wound up at intervals by the motive agent, which is periodically called into action by the revolution of said drum, or a part connected therewith.

393,147. Distribution of Electricity by Secondary Batteries. Henry Edmunds, London, Eng.

The second claim is as follows: "In a system of electrical distribution, the combination, with the secondary batteries, the main circuit, and the working circuit, of a switch or circuit changer comprising a magnet having a coil in the main circuit, whereby the said circuit is diverted from the batteries, and another coil connected with the local circuit, whereby the energy of the first coil can be neutralized or confirmed by a current of the proper direction"

393,159. Synchronizing Mechanism for Clocks. Edward Kronenberg, Philadelphia, Pa.

393,165. Electro Magnetic Shunt for Telephone Receivers. Thomas D. Lockwood, Melrose, Mass.

The invention provides means for relieving telephone instruments from the pernicious and disturbing effects of induction from other circuits, and it is especially serviceable in cases where the said disturbing effects accrue from circuits carrying electric light and power current.

It is based upon the well-known fact in applied electricity that telephone electric currents, by reason of their rapid rate of change per unit of time, pass through electro magnetic helices with great difficulty and with considerable loss of volume and power. Claim 3 reads: "In a telephone circuit, and in combination with the line and the transmitter and receiver in said line, a derived circuit branched from the line between the receiver and transmitter, and shunting the receiver, and an electro-magnet in said derived or shunt circuit."

393,170 Apparatus for Electro plating. Louis McMurray, Baltimore, Md.

393,183. Time Switch for Secondary Batteries. William F. Stocker, Burrton, Kan.

393,192. Electrical Revolving Brush. Russell Thayer, Philadelphia, Pa.

393,203. Gravity Battery. Leon C. Bartley, Cambridge, O.

The first claim is appended: "The combination, with a gravity electric battery, of a receptacle located next under the zinc element, said receptacle being supported by, and connected with, the zinc element."

393,224. Electric Railway. Stephen D. Field, New York, N. Y.

The invention consists in constructing a railway with an intermediate or central line of rails designed to supply the currents to the moving train, and in dividing this central rail into short detached insulated sections, which are supplied with electricity from a stationary generator by means of an electric conductor extending along the entire line, which is connected at intervals with the separate sections through branch conductors. Claim 1 reads: "The combination with a railway track of a series of sectional conductors extending along the line of the track, a continuous conductor, normally completed connections between the respective sectional conductors and the continuous conductor, and intervening circuit interrupting devices."

393,243. Telephone Apparatus. John B. Ker, Harrisburgh, and John Crawford, Reading, Pa.

The invention is designed principally to so construct and arrange the parts of a telephone set that such apparatus can be used in mines of various characters, in chemical works, in military and marine operations, and in like situations where the apparatus will be subject to the action of deleterious gases, or to atmospheric influences injurious to constructions heretofore employed.

393,266. Electric Motor and Dynamo. Andrew L. Riker, New York, N. Y.

The third and seventh claims are as follows:

"3. A ring armature having notches or spaces for the coils, said spaces being of the uniform width throughout, and filled with flat wire approximately the width of said spaces.

"7. The combination, with the armature and shaft, of the commutator mounted on said shaft and comprising the series of sections, each composed of a ring and one or more plates and radial arms, and the holding rings of hard rubber let into the ends of the commutator."

393,275. Closed Conduit for Electric Railway Conductors. Charles J. Van Depoele, Chicago, Ill.

The last claim is given: "In electric railways, the combination, with a foundation piece or base, of the bottom, sides and top pieces forming the conduit, the cross pieces secured to the base and the tie bolts extending therefrom."

393,276. Underground Conduit for Electric Conductors. Charles J. Van Depoele, Chicago, Ill.

The invention is intended, partly, to so construct and arrange the conduit located between the rails, and within which the main conductors for conveying the current to the motors upon the vehicles to be propelled are contained, that both the positive and the negative conductors can be contained therein, disposing of the necessity for using the rails as a return conductor.

The first claim is: "In electric railways, the combination of a closed conduit, positive and negative conductors within said conduit, a traveling contact in independent electrical connection with the inclosed conductors, electric connections in the path of the traveling contact, and extending to the exterior of the conduit, and translating devices completing a working circuit."

393,277. Turnout and Crossing for Underground Conduits. Charles J Van Depoele, Chicago, Ill

Broadly stated, the invention consists in providing special conductors at intersecting points, said conductors engaging some portion of the contact device to support and guide it in the desired direction and at the proper height, while the exterior carrying devices pass over or through the open spaces in the exposed portion of the conduit formed by intersecting slots.

393,278. Switch for Overhead Conductors. Charles J Van Depoele, Lynn, Mass.

The sixth claim is given: "A crossing or switch for electric conductors, comprising arms connected with and radiating from a centrally located plate or surface in electrical connection with said arms, a conductor attached to each arm, the extremity of an entering conductor being located opposite to the continuation of said conductor leaving the crossing, and a projection upon the central plate arranged to engage the contact device to prevent lateral displacement thereof when passing upon the plate between the ends of the conductors"

393,280. Electric Railway System David G. Weems, Baltimore, Md

393,282 Electro Magnetic Door Opener. Edward A. Wildt, Long Island City, N. Y.

393,304. Electric Gas Lighter. Charles H. Haskins, New York, N. Y.

The main object of the invention is to provide means for always keeping the gas ignited as long as the gas cock is turned so as to permit any flow, and to relight it as often as it becomes extinguished while flowing.

Claim 1 reads: "The combination, with a gas burner, a primary electric circuit, and a thermostatic strip, said strip serving to complete the circuit through said burner when cold, and to open said circuit."

393,315. Electric Meter. William F. Stocker, Burrton, Kan.

393,317. Arched Suspender for Overhead Electric Conductors. Charles J. Van Depoele, Lynn, Mass.

393,323 Switch for Electric Motors. George H. Condict, Philadelphia, Pa

The first of the thirty-two claims is given: "The combination of two electric motors, a source of electric supply, a controlling switch for coupling up the coils of the motors in different orders to vary the resistance offered by said motors, a reversing switch to reverse the current in the motors, and a lock controlled by the movement of the controlling switch to lock said reversing switch from movement at all times except when the controlling switch is moved to cut the normal current out of the motors."

393,337. Electro-Magnet Frederic A. Lane, New Haven, Conn.

The invention is designed to increase the surface of the core without necessarily increasing the size of the magnet, and consists of a magnet composed of a tubular metal core, wire wound upon said core, and said tubular core closed at one end to form the active or contact service of the magnet.

393,346. Electrical Conduit. John Whelan, Washington, D. C.

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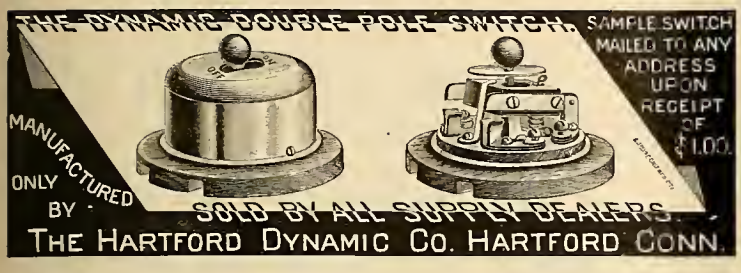

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BEAUTIFUL AND DURABLE.
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NO DIRECT RAYS.
LAMPS INCREASED MORE THAN DOUBLE IN ILLUMINATING POWER.
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SUSPENDED BY FLEXIBLE CORD.
NO FIXTURES REQUIRED.

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CONTRACTS TAKEN FOR THE ERECTION OF

Electric Light Plants Complete.

All Classes of HOUSE WORK a Specialty.

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FOR DYNAMO DRIVING.

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Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: "**A Thoroughly Reliable and Desirable Wire in Every Respect.**"

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

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TRADE MARK.

INSULATED WIRES AND CABLES,

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Manufactured for **AERIAL, SUBMARINE** and **UNDERGROUND USE.** **OKONITE TAPE** for making waterproof joints.

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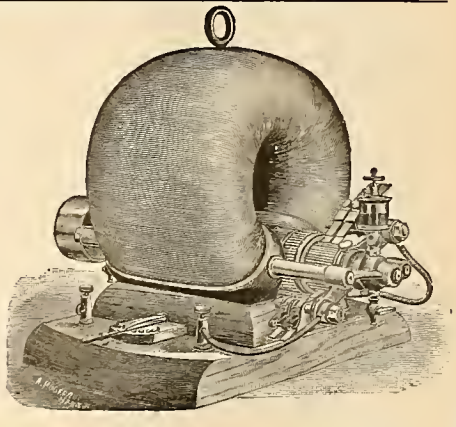

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FOR ELECTROPLATING, ELECTROTYPING, COPPER REFINING, ETC.

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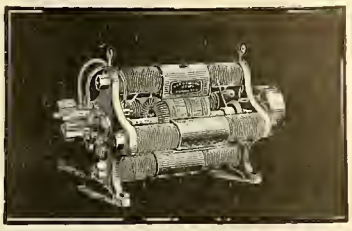

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Sioux City Corliss Engine

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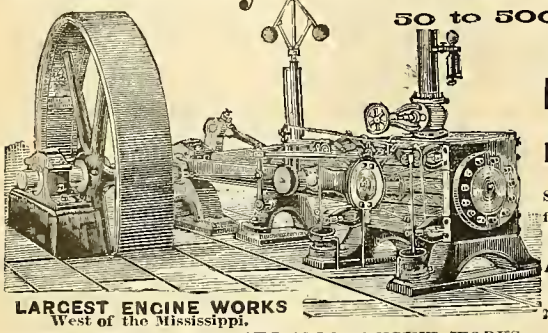

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Steam Power Outfits for Lighting Stations and Elevators

A SPECIALTY.

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And secure better results than you are now getting, thus saving all rebates on account of inferior lights.

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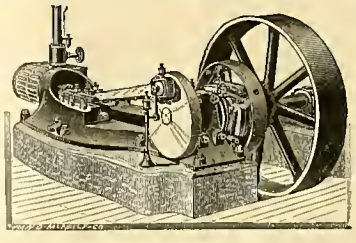

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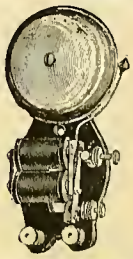

Of dealers and others is called to this bell, the advantages of which can readily be seen in its adjustment for regulating the spring which supports the Armature. By simply turning a screw the spring is made to conform to the strength of battery current, one cup of battery will work it louder and stronger than will two or three others of different make.

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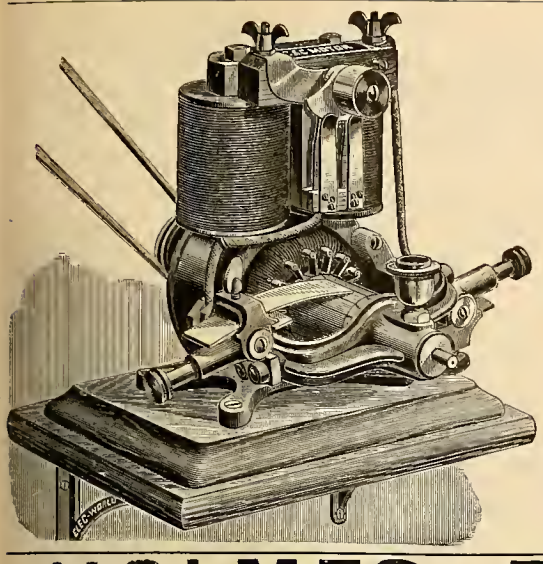

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EFFICIENT ELECTRIC MOTORS

MANUFACTURED FOR ARC AND INCANDESCENT CIRCUITS.

AUTOMATICALLY REGULATED.

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Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

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Acknowledged to be the Leading System, for Superiority in all the vital points that go to make up a First-Class System.

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Long Distance Series and Multiple Arc Incandescent Lighting.

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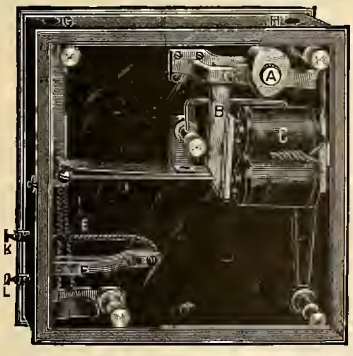

Protect your Armatures

It is a matter of everyday experience among Electric Light men that Armatures are frequently burned out entirely, or seriously injured by the short circuiting of machines. This entails delay, trouble and expense.

Wright's Armature Protector Absolutely Protects

Armatures from injury resulting from the short circuiting of machines. No machine can burn out if protected by Wright's Armature Protector. One of the most valuable inventions of recent years.

"Adapted to any System"

Now on the market. For information and prices, address

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See letter of recommendation from electrician Chicago Arc Light & Power Co., on advertising page xiii WESTERN ELECTRICIAN July 28, 1888.

SYNOVIAL
Dynamo and Cylinder Oils.

Second to none. Free from gum or acids. Especially adapted for all fast runnning machinery. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

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The only Mechanical Telephone which has stood the tests and held out and given satisfactory service for the past eight years.

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ELECTRICAL GOODS OF EVERY DESCRIPTION.

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GENUINE GONDA POROUS CELL BATTERY COMPLETE.

DO NOT BE DECEIVED

By imitations marked Leclanché Disque or Disque Leclanché. The term "Disque" was formerly used by us to designate a certain size of cell as distinguished from size No. 1 and size No. 2. It has no reference whatever to the quality of the Battery.

THE CELIBRATID TRADE **GONDA** MARK. is the Genuine Battery.

GENUINE GONDA POROUS CELL AND ZINC.

It is unlike any other Porous Cell Battery made, or by whatever name called, and is immeasurably superior in efficiency and durability.

DO NOT BE IMPOSED UPON.

Insist upon being furnished with the Genuine Gonda Porous Cell, and if your dealer does not keep it send to us direct for prices. Do not use any zinc with our cell unless it is stamped with the word Gonda.

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CANDEE IMPROVED WEATHERPROOF WIRE.

A full stock of ELECTRICAL SUPPLIES of Every Description.

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GILES ANTI-MAGNETIC SHIELD FOR WATCHES.

Office of Van Depoele Electric M'fg. Co.
Chicago, Feb. 16, 1886.

Anti-Magnetic Shield & Watch Case Co.

Gentlemen : — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good time-keeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.

Sure protection from all Electrical and Magnetic disturbances. Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
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The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and in operative on account of their susceptibility to the all-pervading magnetic influence.

AMERICAN WATCH CO.,
Waltham, Mass.

GILES BROS. & CO. 103 State Street, CHICAGO.

THE LIST OF SALES OF THE

Westinghouse Engines: Compound, Standard and Junior,

FOR THE MONTH OF OCTOBER, 1888,

Is too long to publish *in extenso* as an Advertisement. Orders were received on eighteen working days, the five heaviest days yielding respectively, 16, 11, 10, 8, and 7 ENGINES EACH.

TOTAL, 86 ENGINES, AGGREGATING 3310 H. P.

Sales for August, September and October were over 200 ENGINES of all types, aggregating nearly *10,000 HORSE POWER*. Note in connection with the above exhibit, that our current advertising expenses for 1888 are about one-half that of any preceding year.

WHY IS IT?

The Woodbury

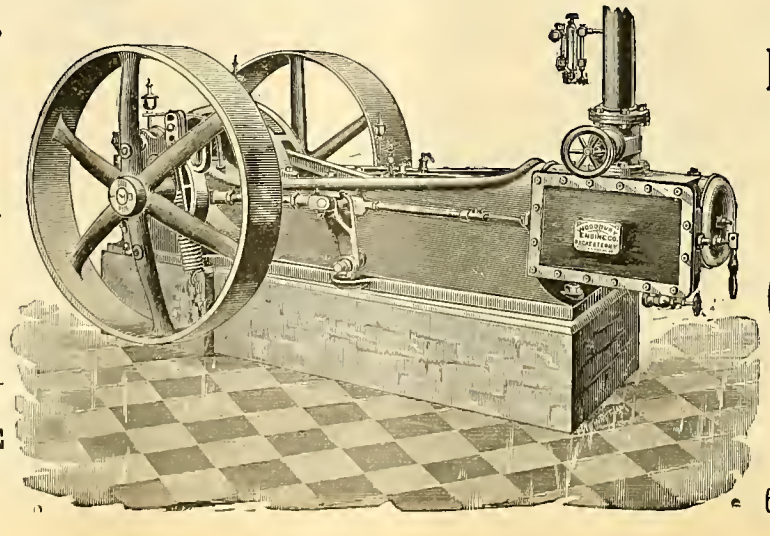
AUTOMATIC

Cut-Off High Speed

ENGINE.

MANUFACTURED BY

WOODBURY ENGINE COMPANY.



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PLAIN SLIDE VALVE

—AND—

Double Valve Medium Speed

AUTOMATIC

Cut-Off Engines

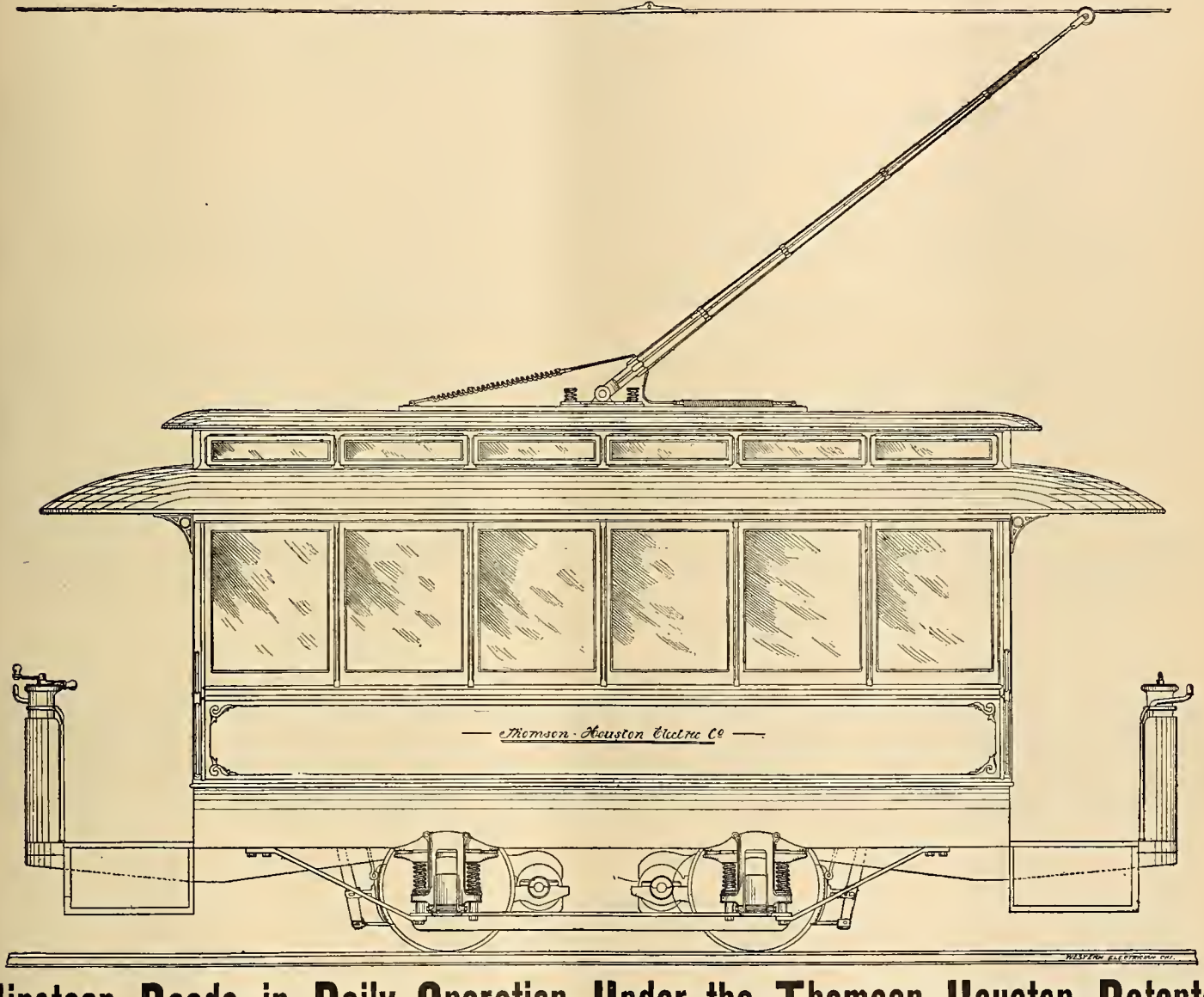
—AND—

TUBULAR BOILERS.

Address the Manufacturers at

652 Mill Street, ROCHESTER, N. Y.

The Thomson-Houston Electric Railway System.



Nineteen Roads in Daily Operation Under the Thomson-Houston Patents.

ALL MATERIAL IS NOW MANUFACTURED AT THE **FACTORY** *AT* **LYNN,** *MASS., THE LARGEST AND BEST EQUIPPED ELECTRIC FACTORY IN THE WORLD.*

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Thomson-Houston patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

MOTORS & ELECTRICAL EQUIPMENTS FURNISHED FOR MINING & OTHER SPECIAL WORK.

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READY DECEMBER 10.

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By F. B. BADT.

100 pages; 80 illustrations; flexible cloth binding; type page 6x3 inches.

PRICE $1.00.

THE ONLY BOOK OF THE KIND PUBLISHED.

First Edition Twenty-five Hundred Copies.

ORDERS ALREADY ON FILE FOR MORE THAN ONE-HALF THE ENTIRE EDITION.

Forward Your Order NOW.

SENT POSTAGE FREE ON RECEIPT OF PRICE.

ELECTRICIAN PUBLISHING COMPANY,

6 LAKESIDE BUILDING, CHICAGO.

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By F. B. BADT.

100 pages; 70 illustrations; flexible cloth binding; size of type page, 6x3 inches.

Designed for Dynamo Tenders and Linemen, Stationery and Marine Engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

Price, Postage Pre-paid to any address in United States or Canada, $1.00

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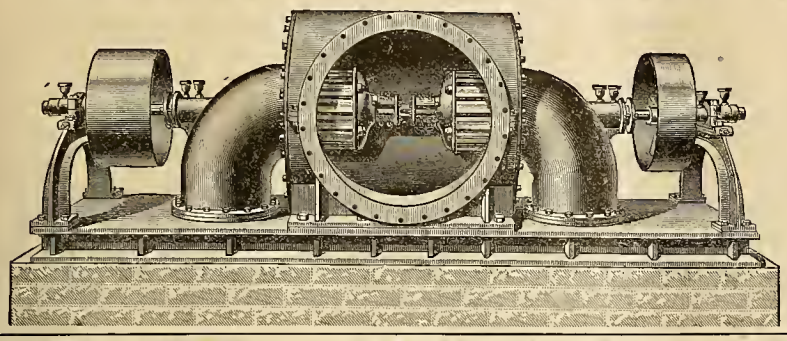
ELECTRICIAN PUBLISHING COMPANY,

6 Lakeside Building, CHICAGO.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL**, as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft, with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

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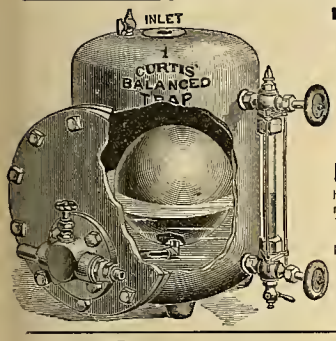
THE GLOBE CARBON CO., CLEVELAND, OHIO.

CARBONS FOR ELECTRIC LIGHTS, BATTERIES, ETC.

Office and Works, - - - - C. & P. R. R. EUCLID STATION.



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MANUFACTURED BY

THE CURTIS REGULATOR CO.

Beverly St., Boston, Mass.

HAS balanced Valve, therefore works equally well under HIGH or LOW pressure; discharges full area of pipe; has hard composition float, vented to the atmosphere, and is warranted not to collapse or fill.

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ELEMENTS OF ELECTRIC LIGHTING

BY PHILIP ATKINSON, Ph. D.

260 Pages, Cloth Binding, Illustrated, Price $1.50.

This book is an elaboration and revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. It treats of: Principles of the Dynamo; Alternate Current Dynamos; Direct Current Dynamos; Electric Terms and Units; Electric Measurement; The Arc Lamp; The Incandescent Lamp: The Storage Battery; Electric Distribution.

Sent postage prepaid on receipt of price.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, Chicago.

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- Fire and Burglar Alarms.
- Electro-Medical Apparatus.
- Electric Lighting.
- Telegraph Instruments.
- Wire and Batteries.

The United Electric Co.

Electrical Apparatus and Supplies,

SALT LAKE CITY, - UTAH.

THE FINEST LINE OF

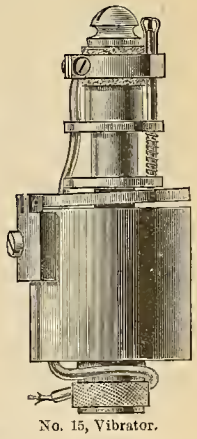
Electric Gas Lighting

BURNERS.

BOTH HAND-LIGHTING AND AUTOMATIC.

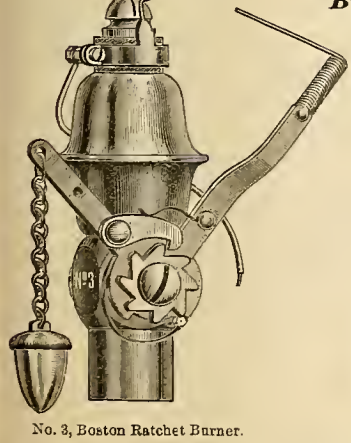
IT PAYS TO USE THE BEST.

No. 4, S. M. R. Automatic.

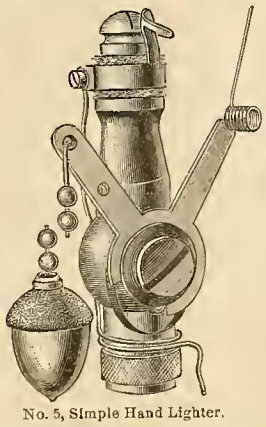


No. 15, Vibrator.

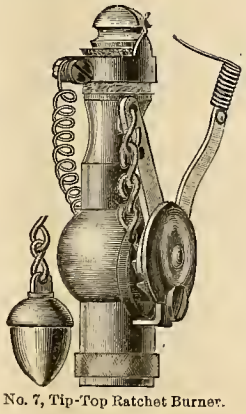
SPECIAL NOTICE.—This Company enjoys the notable distinction of having received the Highest Award over all competitors at the American Exhibition, London, Eng., 1887, viz: A Diploma of Honor, for the best Exhibit of Electric Gas Lighting Apparatus, Annunciators, Burglar Alarms, Electric Bells, Etc.



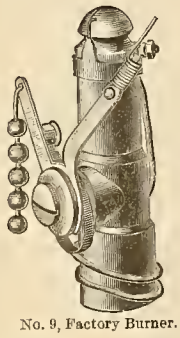
No. 3, Boston Ratchet Burner.



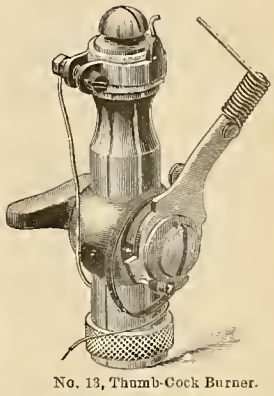
No. 5, Simple Hand Lighter.



No. 7, Tip-Top Ratchet Burner.



No. 9, Factory Burner.

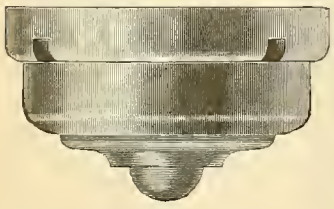


No. 13, Thumb-Cock Burner.

Manufactured by THE ELECTRIC GAS LIGHTING CO., 35 Arch St., Boston, Mass.

The Stoddard Combined Rosette

AND CUT-OUT.



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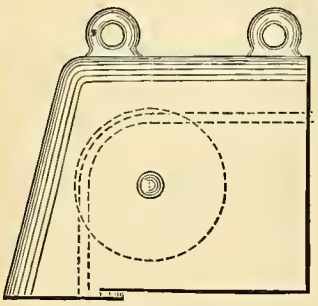

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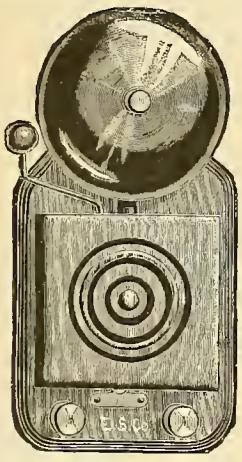
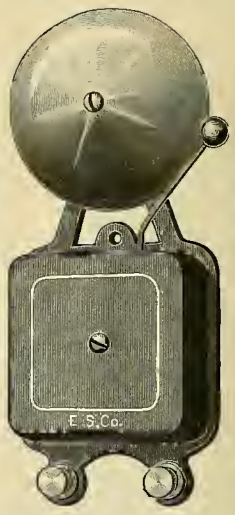


HANDSOME WOOD BOX.

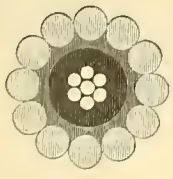
STYLE NO. 610.

DUST PROOF.



IRON BOX.

STYLE NO. 640.



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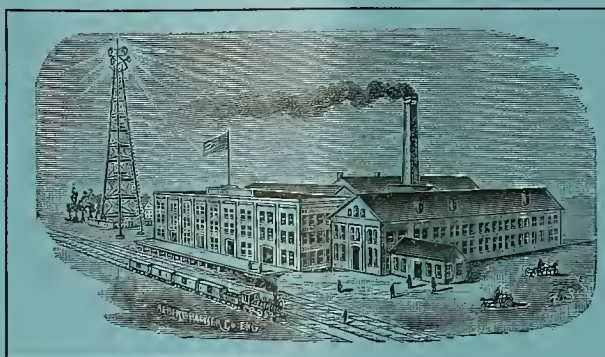

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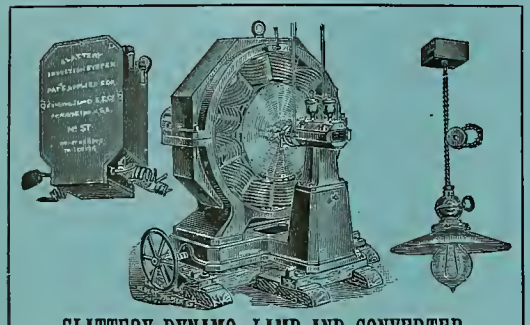

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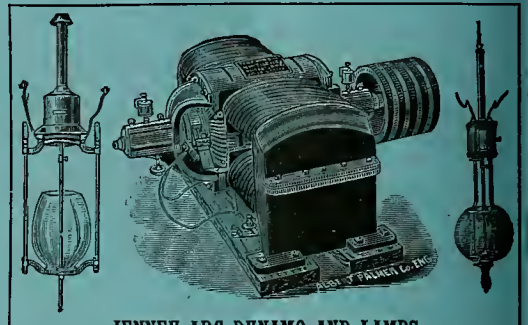

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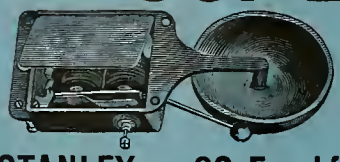
Superior to  All Others.

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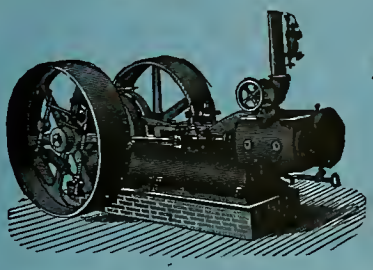

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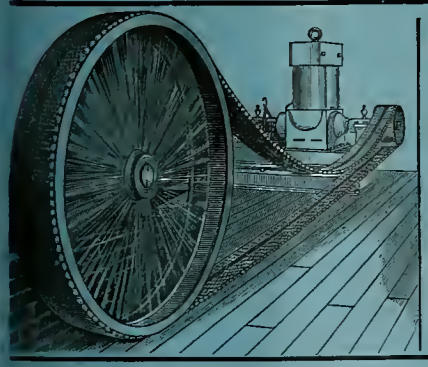

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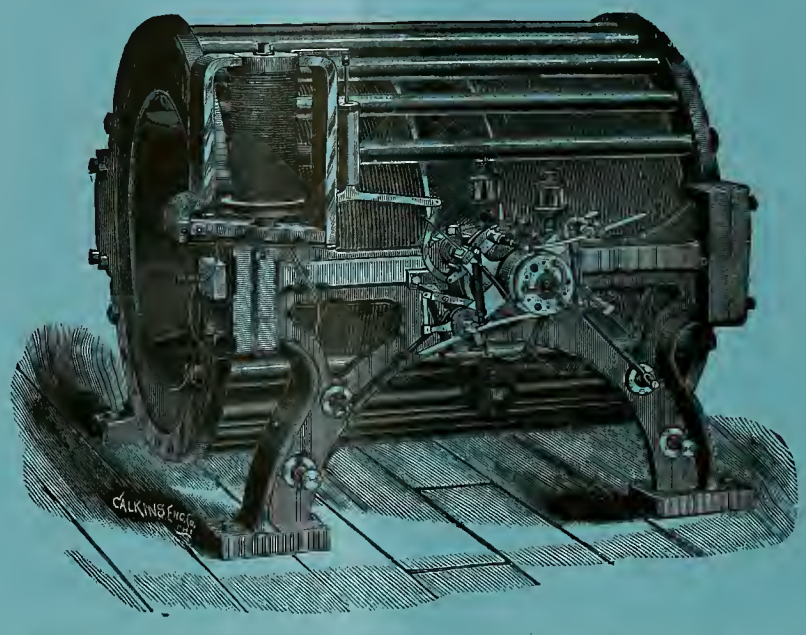

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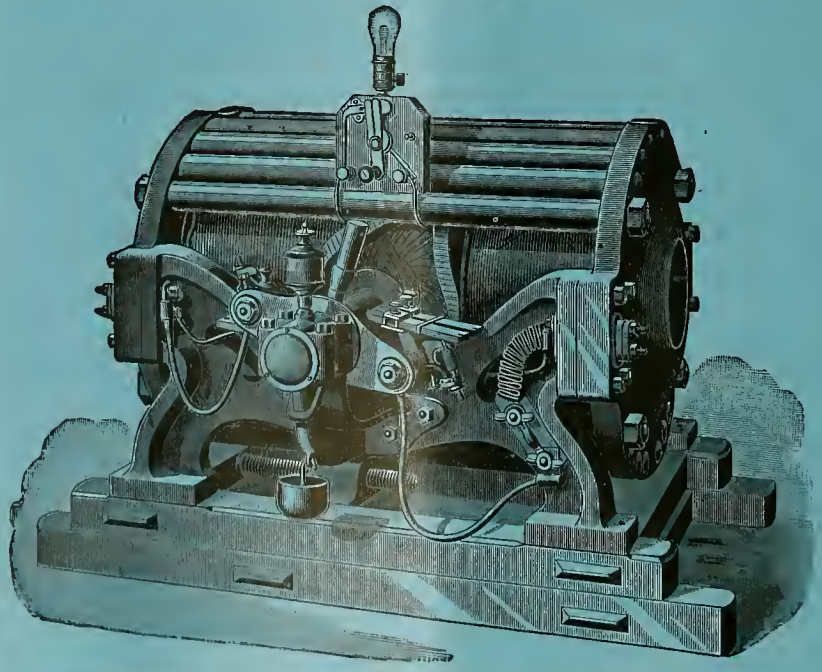

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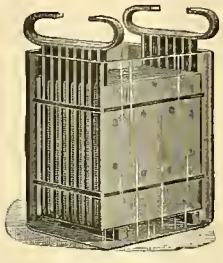

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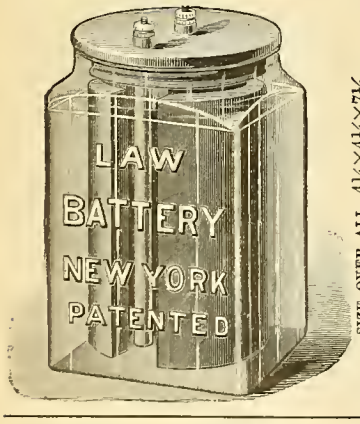

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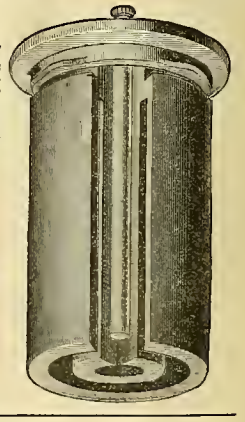

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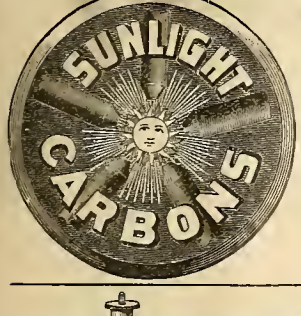

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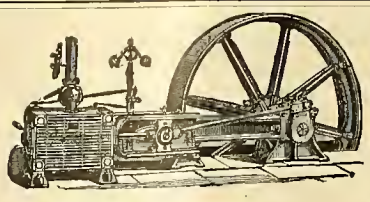

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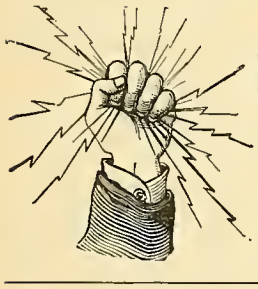

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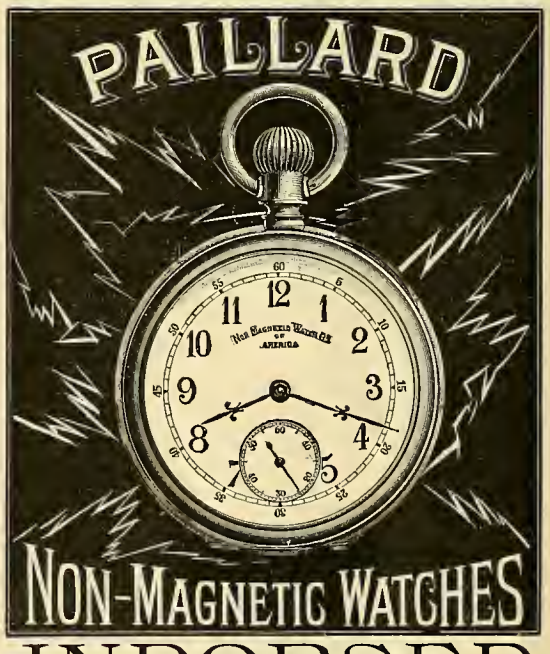

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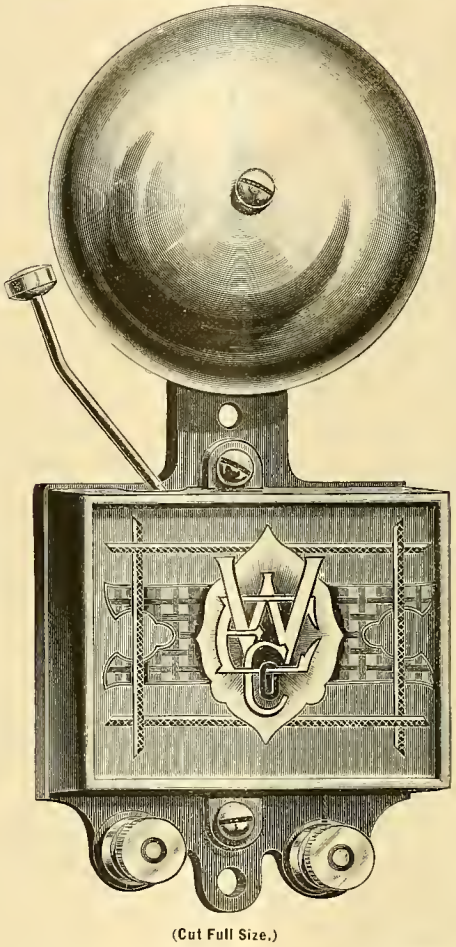

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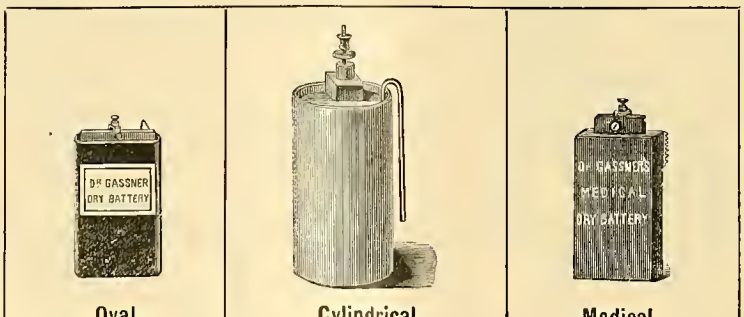

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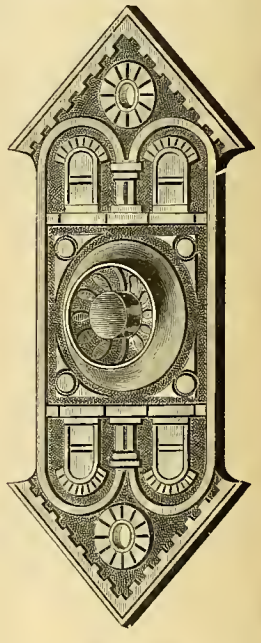

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The New Thone Electric Motor.

The accompanying engravings present the recent improvements in the Thone motor, manufactured by the Hawkeye Electric Manufacturing company, which has recently removed its works from Oskaloosa to Davenport, Ia. The most important feature of the new motor is the switch and starting device, which is given in the engraving of the 2 horse power motor, Fig. 1, so arranged that all danger to the circuit and motor is avoided. It is a very simple device, fully protected by patents, and in connection with other improvements, makes the machine one of the best now on the market. The advantages of the new motor are great regularity of speed, extreme simplicity, the entire absence of parts requiring frequent adjustment, small space, and a compact and rigid form, together with the very best of material and workmanship. The 10 horse power motor, Fig. 2, is a new type of the Thone motor, but differing only in the employment of four field magnets instead of two, as in the smaller sizes. These motors are now made in sizes from one-half to 25 horse power.

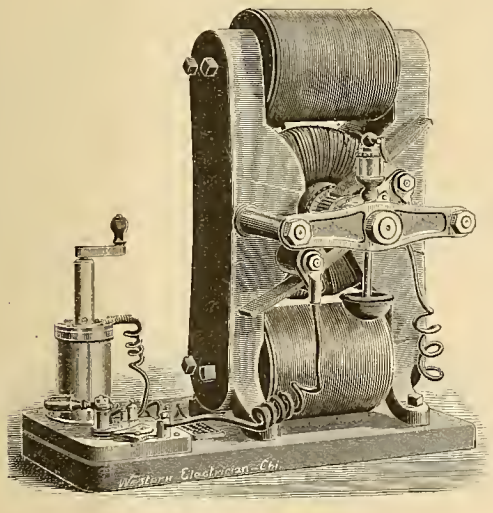


FIG. 1.

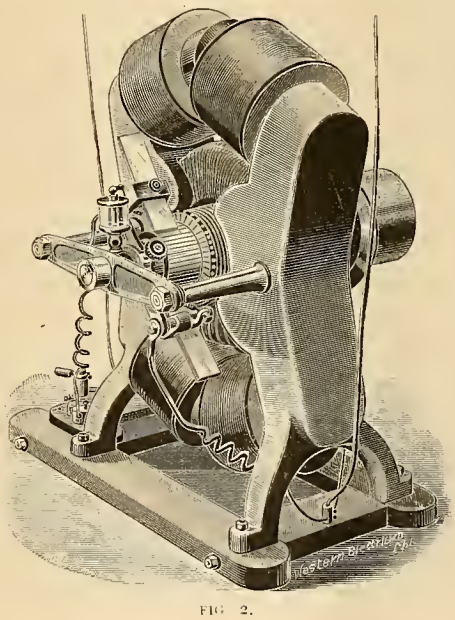


FIG. 2.

Chicago City Electric Lighting.

Although over two weeks will elapse before the new electric light station in Chicago will be in operation, there is already considerable discussion as to the advisability of extending the system. The finance committee has requested City Electrician Barrett to submit estimates for extending the city's electric light plant in all three divisions of the city. It is the intention to operate an independent plant from the north side waterworks which will illuminate Clark street to North avenue, North avenue west for some blocks, Wells street from Division to the river, Chicago avenue from Wells to the lake, State street south of Division, and one of the residence streets, Pine or Rush street probably. In the south side it is the intention to extend the electric lights on Wabash avenue as far as Twenty-second street; on State street to Twelfth, crossing the river to Blue Island avenue, north on Blue Island avenue to Harrison street, and east on Harrison street to connect with State street on the south side.

A number of the aldermen think that $100,000 should be appropriated for this purpose next year. The action of the council will depend upon the results of the experiments with the 150 lights which will illuminate the central portion of the city after Christmas.

Mayor Roche has proposed to Professor Barrett that the plant now used in lighting the river as far south as Twelfth be taken out as soon as the new street plant, which will also furnish down-town river lights, is in operation; that this old plant be transferred to the southwest side, and operated from the southwest waterworks for the illumination of the river as far as Main street, or beyond to Twelfth street. Professor Barrett says the mayor's plans can be carried out with little cost.

Protection and Electric Lighting.

"Electric light companies will have to adopt before long a general policy of protecting their customers," said a gentleman identified with the business. "Let me indicate just what I mean. Suppose a plant has been sold to a company in, say, Smithburg. The owners very likely will furnish lights for the city. The time may come sooner or later when the aldermen of Smithburg deem it advisable to purchase a plant. They will solicit bids, and all the companies in the country will enter into a general scramble for the contract. But what is the company going to do which has been furnishing the city lights? If the aldermen go outside and buy a new plant, the company has its old plant thrown back on its hands. It is practically valueless. The investment will be almost a total loss. There ought to be a well-understood agreement in such a case as I have cited, that all the companies should let Smithburg entirely alone. Of course if our company had installed a plant at Smithburg we would not interfere when there was talk of purchasing a new plant; but our attitude would not help the local company. We would merely demonstrate that, in so far as possible, we would stand by the company. We might lose the contract for the new plant by not joining in the fight for it. The companies must agree to stand by their customers. A company cannot prosper if its customers are all losing money. It will come to this in the near future, that the company that interferes in the way I have indicated with another company's customers will be tabooed in the electrical world. This matter, you will remember, came up at the last Electric Light convention, and it will come up again in February, and it will keep coming up until the matter is settled. You will not have to go very far back to find examples similar to the case of Smithburg. They are constantly occurring, but I trust the number of cases will grow smaller and smaller. Whatever I may be in national politics, I am a thorough-going believer in protection in the electric lighting business. It is a matter which I hope all those interested in the future of the business will think of. It ought to be well ventilated in order that definite action may be taken at the electric light convention."

The Telephone Question in Chicago.

A meeting of the finance committee of the Chicago city council was held November 30th to consider the telephone question. F. S. Winston, who appeared for the telephone company, said the intention of his clients was to present the committee, as an alternative to prolonged litigation, a compromise ordinance granting to the city the free use of instruments for all the municipal offices, fire department and police department sets at nominal prices, and 2½ percentage on gross receipts. In return for this concession it asked the council to grant the company the right to extend its wires and to operate its system without threats of vexatious litigation or attempt to regulate its rates. He introduced an ordinance covering this proposition, the principal section of which is as follows:

SEC. 6. The said Chicago Telephone company shall file with the controller of the city on the first day of January and July of each year a statement of its gross receipts from the telephone business done by said company within the city of Chicago for the six months next preceding such statement, which statement shall be sworn to by the president and secretary of said company; and at the time of filing said statement the said company shall pay into the city treasury two and one-half ($2\frac{1}{2}$) per cent. on such gross receipts, and said company shall not increase the rates it is at present charging to its subscribers. And the company

shall connect its wires with the mayor's office, department of public works, fire department, police department, building department, city collector's office, city clerk's office, health department and law department, and place and keep one telephone in each of said places free of charge to the city, so that said telephones may be used in connection with all wires under control of said company connected with its exchange in the city of Chicago; and said company shall also rent to the city of Chicago telephones for the sole use of the police and fire alarm systems of the city of Chicago at an annual rental of not to exceed five dollars ($5) per annum for each telephone outfit: Provided, however, That nothing in this ordinance contained shall be construed or taken as preventing the city of Chicago, whenever it shall be authorized so to do, from passing an ordinance regulating the rates to be charged by telephone companies for the rental of telephones or for licensing of telephone companies, it being the intention of this ordinance that the city of Chicago shall in no way surrender any rights it may have or may hereafter acquire to license telephone companies or to regulate the prices to be charged for telephones; but upon such licensing or upon such regulation of such prices then the provisions of this section as to payment of revenue and furnishing of telephone facilities to the city of Chicago, shall cease to be binding upon said company: Provided, also, That nothing in this ordinance contained shall be construed as preventing the city of Chicago from granting an ordinance to any other telephone company.

Representatives of the Druggists', Livery-men's and Undertakers' associations protested against the acceptance of the ordinance. They were anxious that the council should hold out for a reduction in telephone rates. No definite action was taken. Mayor Roche and the city controller are said to favor a compromise of this kind if the percentage of gross receipts which the company shall pay into the city treasury be increased to 6 per cent.

On the day following the meeting of the finance committee the telephone company took a decided step to strengthen its position in the city. A note was handed to Mayor Roche, signed by President Phillips of the telephone company, announcing that hereafter all applications for permits to string wires, etc., would be made in the name of the Bell Telephone company. When the dispute between the city and the company was renewed, and it was asserted that the company was acting without a franchise, the attorneys of the latter took the position that the corporation could operate under the franchise granted to the parent company; it could make applications in the name of the original company. The city council claimed that this franchise had been forfeited by non-user, and that it could not be transferred. Mayor Roche, when asked his opinion of the new position of the company, said: "The action is a surprise to me. I expected a favorable arrangement. The finance committee could not have accepted the 2½ per cent. offered by the company. The people demanded a reduction of rates. The matter must now be fought out in the courts."

Corporation Counsel Green was non-committal, but as showing the correctness of his opinion declaring the transfer of the franchise illegal, he was manifestly pleased. "I do not care to express an opinion now," said he, "as I will doubtless soon be called on to express an official one, which I must be prepared to defend. It is a matter that must now be settled in the courts if the council declares the Bell ordinance forfeited for non-user."

F. S. Winston, attorney for the Chicago Telephone company, gave this opinion on the merits of the controversy: "It was at my suggestion that the company made its final proposition to the committee, in which it offered to pay the city from $25,000 to $30,000 a year in the way of revenue and telephone facilities until such time as the city should obtain and exercise the right to regulate the telephone rates. The company can do no more than this, and I challenge any one to name a case where the city has ever received a more liberal offer from any corporation. But the committee has seen fit to vote against the acceptance of the offer, and it seems apparent that no fair adjustment of the difficulties can be reached. Hence the company has decided to fall back upon its rights under the ordinance of September 9th, 1878. To this end we have now placed matters in good shape for a lawsuit, if one must come, and whatever may be decided as to the right of assignment under that ordinance, I venture to predict that the final result of the suit will be that the existing wires and telephones will be protected by the courts. We have made every honorable effort to reach an agreement with the city and have failed, and the numerous applicants for telephones will have to await the result of the litigation."

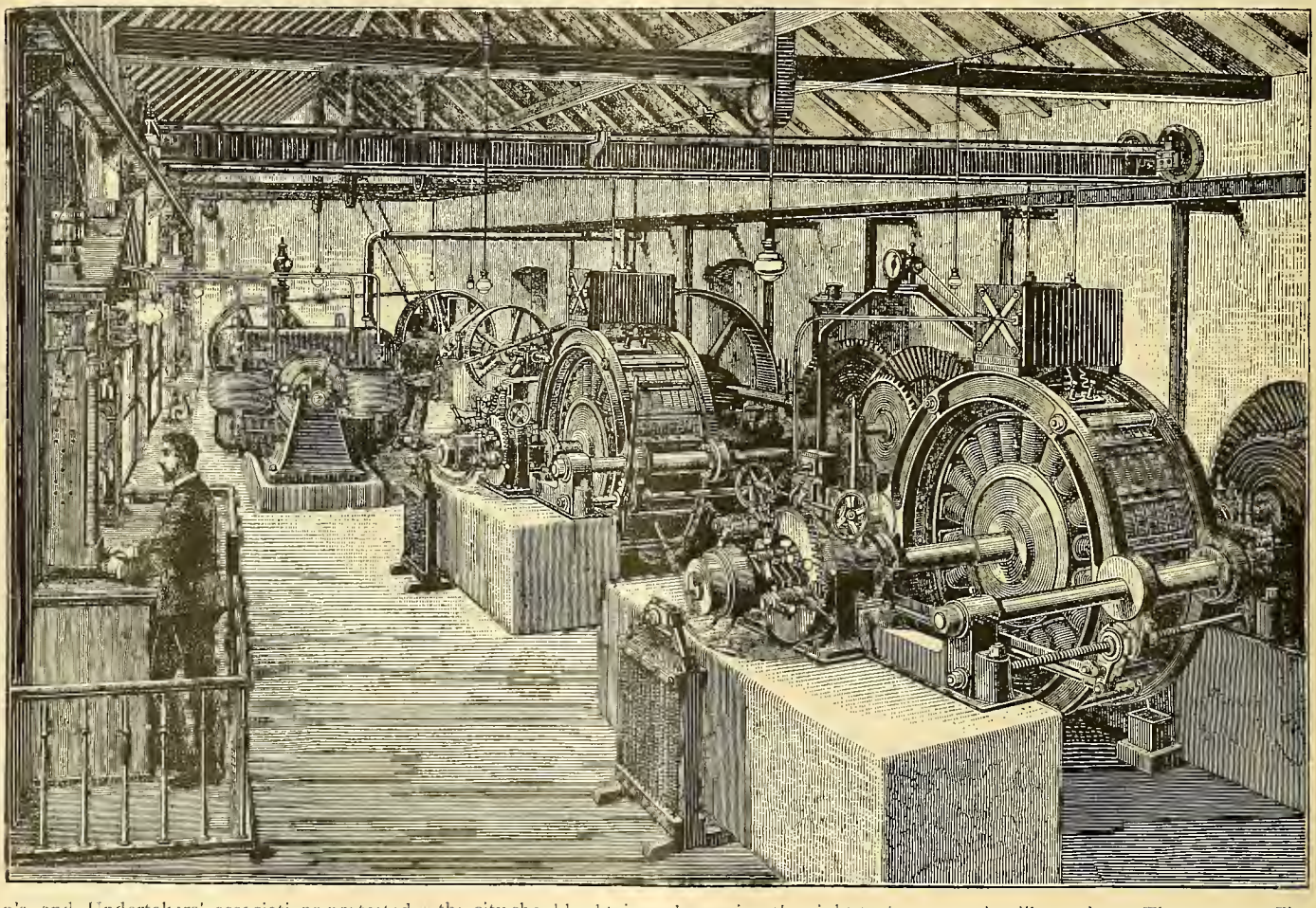
The work on the electric road at Scranton, Pa., to be installed upon the Sprague system, is being pushed forward as rapidly as possible, and it will not be long before all the cars will be in operation. The electrical equipment of this road will include 20 motor cars, to be operated over 12 miles of track.

Light and Power Plant at Thorenberg.

In a recent issue, *La Nature* describes an interesting installation for the production of electrical energy for both light and power. This installation is at Thorenberg, a point on the line from Lucerne to Berne, near Litau station, about three miles distant from Lucerne. Here there is a waterfall 25 feet in height, derived from the Emmen river.

Mr. Troller, owner of a steam flour mill located three miles from the fall, conceived the idea of utilizing the latter and establishing a plant to generate electricity to light a part of the city of Lucerne, and furnish power to run his mill. At the waterfall the generating station is located. A turbine actuates a large shaft which extends along the entire length of the works, and runs two series of generators; alternating current generators, serving for the lighting of a part of the city of Lucerne; and a continuous current machine, the current of which actuates, at a distance of three miles, an electric motor that runs Mr. Troller's mill.

The interior of the station is shown in the accompanying illustration. There are two Zippernowsky alternating current machines of 150 horse power, which supply a certain number of transformers distributed through Lucerne at the centers of the chief points of consumption. When running normally, each machine is capable of producing 1,800 volts at the terminals, and 40 amperes. The conductors are double and consist of copper wires one-fourth inch diameter.



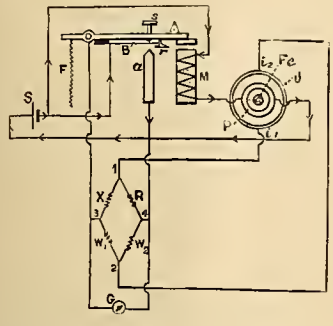
Inasmuch as the distribution of current is over a wide area, compensators are used. The compensator is a small transformer whose inductive circuit is mounted in the general circuit of the system of distribution, and is traversed by the total current of the machine, while the induced current is connected with the excitation of the machine. The excitation itself forms a special circuit, and is produced by one of the twenty induced bobbins of the machine, the nineteen others serving to produce the main current.

The plant is supplying 3,500 Swan incandescent lamps of 10 candle power, 35 watts, but, as all these are not lighted at the same time, a single machine suffices to perform the service. The light is paid for by contract, at the price of $4 per lamp per year.

Method for Measuring the Resistance of Electrolytes.[1]

By Johann Carl Purthner.

In measuring the resistances of electrolytes the alternating currents of an induction apparatus are often used to avoid polarization. If the Wheatstone bridge is used the absence of a current in the corresponding branch of the bridge can be shown only by means of an electro-



dynamometer, or a telephone, the latter instrument being generally used for this purpose. But if this instrument is employed it is impossible to judge from its tones whether the variable resistance must be increased or diminished, and it cannot be brought to silence, which renders the measurement more difficult, and involves an inaccuracy of several per cents.

But without giving up the use of alternating currents, these and other disadvantages of the use of a telephone—physical exhaustion and insulation of the observer—may be obviated if in the branches, X, R, w_1 and w_2, we retain the alternating currents, but separate any alternating currents existing in the direct connection of 3 and 4 into direct and inverse currents, thus obtaining currents of uniform direction which can be demonstrated by means of a galvanometer.

For the production of induction currents of equal intensity and duration the arrangement of Helmholtz is applied, wherein the direct currents are produced, not by interruption, but by short-circuiting the primary current. In the apparatus described for separating the induction currents the spring, S, connected with one pole of the source of the primary current, S, is arranged below. The contact, *a*, is connected with the other pole, and the electro-magnet, M, as well as the primary bobbin, P, are in direct connection with the poles of the source of the primary current.

In the position of rest, when A touches the screw, *s*, the circuit is closed by the primary bobbin, P, and the electro-magnet, M, which attracts the keeper. In the downward movement the spring B reaches the contact pin *a*, short-circuiting the primary current and disconnecting the bobbin, P, and the electro-magnet, M. In consequence of the counter action of the spring, F, there follows an opposite movement, removing B from *a* and reintroducing the primary bobbin and the electro-magnet.

The one end, i_1, of the induction coil, J, is in connection with 1, the other end, i_2, with 2. The alternating current therefore traverses the branches, X, R, w_1 and w_2, when X signifies the resistance to be measured, R the rheostat, and w_1 and w_2 the proportional resistances.

In order to separate any currents existing in the direct connection of 3 and 4, 3 is connected with the beam, A, and 4 with the contact pin, *a*.

When the electro-magnet attracts the keeper, and the spring, B, reaches the contact pin, *a*, whereby the direct induction currents are occasioned, any currents existing in the direct connection of 3 and 4 are short-circuited by the beam and the contact column. If B withdraws from A, the induction current conductor is short-circuited by the beam and the contact column, and the inverse induction currents traverse the by-circuit, in which is the galvanometer, G.

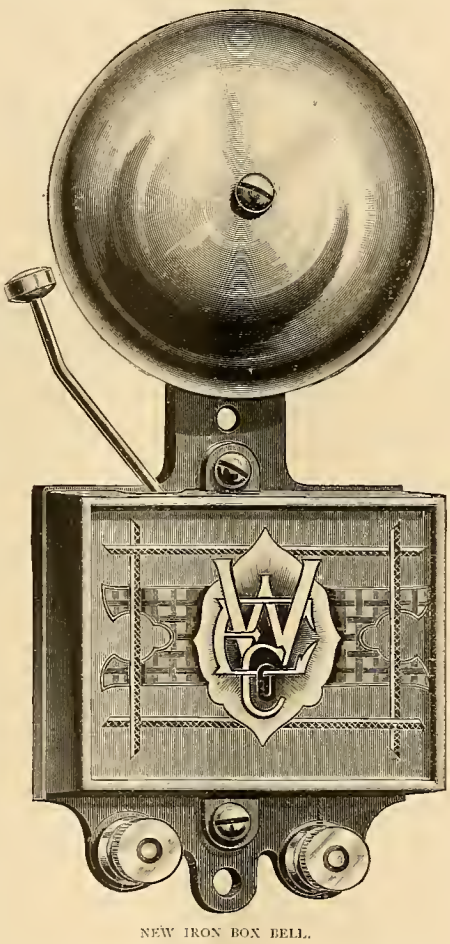
From any deflection of the needle which is produced it may be seen whether an increase or a decrease of the variable resistance is necessary, which cannot be at once recognized, even on using an electro-dynamometer.

In measurements undertaken in the Physico-Chemical Institute of the University of Vienna it appeared that by the method just described more accurate results could be obtained than by the use of a telephone, and in much less time.

In a similar manner the method of substitution may be applied in measuring the resistance of electrolytes, the decomposable conductor, and afterward the rheostat, being intercalated in the alternating circuit of the induction bobbin, while the galvanometer is in a circuit traversed only by currents of uniform direction.

In measuring the resistances of electrolytes by means of the differential galvanometer, the conduction leading from one end of the induction bobbin is divided into two branches, in one of which is introduced the electrolyte, and in the other the rheostat.

In order to obtain in each branch induction currents of uniform direction the separation of the currents in each of these two conductions



NEW IRON BOX BELL.

Zeitschrift fur Elektrotechnik (Part III., 1888) may be used.

As a matter of course the arrangement of must be effected separately, for which purpose an apparatus described by the author in the Vienna Helmholtz can be applied as in the apparatus shown in the figure, and the separation of the induction currents can also be effected by obtaining some of them in by-circuits into which are inserted the coils of a differential galvanometer.

[1] Abstract in London *Electrical Review* from *Wiedemann's Annal. n.*

New Iron Box Bell.

A new style of iron box bell is shown in the accompanying engraving. The back is solid cast iron. The connections inside are platinum pointed, and the bell is adjusted to ring on from one to five cells of battery. The design is handsome, and the bell though cheap in price is constructed in a thoroughly workmanlike manner. It is one of the latest productions of the Western Electric company.

Paget Storage Battery and its Applications.

Among the patents reported in the usual place in this issue of the Western Electrician are several devoted to the storage battery and its applications, issued to Leonard Paget of New York.

Patent number 393,573 relates to improvements in storage batteries, in which the active material is applied to one of the electrodes, while the other electrode is what is known as the Planté type. The objects of the invention covered by the patent in question are first to obtain a porous positive electrode affording a ready exit for the gases developed thereon and an even circulation of the electrolyte through it; second, to construct a negative electrode in such manner that the supporting frame shall present a minimum amount of absorbent surface, and that the greater portion of the support for the active material shall not be directly exposed to the electrolyte, thereby preventing the development of hydrogen on the surface of the frame instead of the reduced lead, and avoiding the development of false electromotive force attained at the surface of the electrode or plate, during the process of charging. It is the further object of this form of support to more securely hold the active material. An additional object of the invention is an improved electrolyte which gives much more rapid formation of the positive plate or electrode than is possible with a plain lead electrode suspended in an electrolyte of dilute sulphuric acid. A still further object is to increase the capacity and rates of charge and discharge of the battery, as well as to make it more durable.

Fig. 1 of the accompanying cuts is a side elevation of the negative plate, showing the active material in position at the left side, and the retaining grids or bars for holding the active material at the right hand side, the active material being removed, so as to show them. Fig. 2 is a similar side elevation of the positive or lead plate.

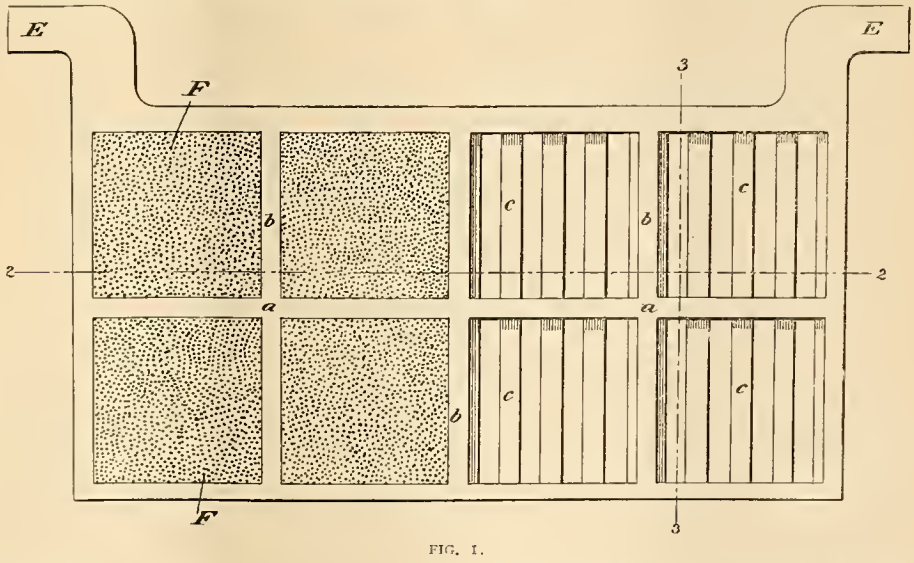


FIG. 1.

The retaining plate A, Fig. 1, is cast of pure lead, in the shape of a frame having the usual contact lugs or ears, E E, and cross bars *a a b b*, which divide the frame into sections for holding the active material, while an additional set of

cross bars, *c c*, are at the same time cast with the frame, but at a lower or depressed level than the first-named cross bars *a a b b*. The active material F, of the usual type, is pressed into the rectangular spaces on both sides of the plate, as clearly shown on the left side of Fig. 1 in such manner as to entirely fill the spaces. It will be seen that by this arrangement all the sustaining bars *c* are entirely embedded in the active material, the only portion of the frame exposed to the electrolyte being the ribs *a b*, and the end and bottom ribs, and even this surface may be reduced to a minimum by making the ribs *a a* and *b b* -shaped, as will be understood.

The inventor states that he has found by experiment that with electrodes or plates in which portions of the supporting frame are largely ex-

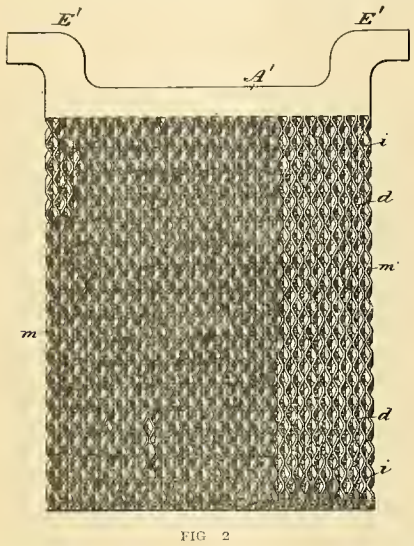


FIG 2

posed with the active material there results local action, as well as deleterious effects, due to buckling, by virtue of the expansion and contraction of such exposed parts, and the improvement avoids these difficulties by presenting a minimum surface of such parts. The ribs *a b* may be covered by wooden, vulcanite, or glass strips, as is usual in storage batteries where it is desired to separate the positive and negative electrodes.

The positive electrode, Fig. 2, is composed of corrugated lead strips *m m'*, set, as shown, in a suspensory beam of type-metal, A', having ears or lugs E' E'. These strips are preferably attached to this suspensory beam by being cast into it, and rest one against another, the corrugation of each alternate strip producing grooves which run in the opposite direction, while those of the succeeding alternate strips produce grooves which run in the opposite direction, the strips being placed back to back, as clearly shown in the cut, the first set of openings, *i*, passing from the front of the plate to the rear, and the second set, *d*, passing from the rear to the front, the two sets being inclined to each other at an angle. The suspensory beam A' constitutes the sole support of these lead strips, they being entirely free at their lower ends, but always in contact with each other.

The electrolyte has a positive circulation in both directions through the electrode, and a maximum surface is obtained with a minimum amount of material, while the corrugated strips are so related to each other as to make a comparatively solid and firm electrode. During the process of charging and discharging an electrode of this nature there is an expansion and contraction of about 10 per cent. of the normal length of one of the strips. Were both ends of these strips rigidly fastened, or were they allowed to dangle freely and independent of each other, serious results would follow. These corrugated strips are constructed in such manner that the corrugations must be equal in width or length to the width of the strip, and they are located at such angle as to connect the diagonal points of the rhomboid which is formed by them. A plate or electrode constructed after this manner presents such an enlarged surface that it is rendered much more porous and allows much freer passage for the gases and for the interchange of the electrolyte than with any of the known forms with which the inventor is acquainted.

The electrolyte, which is designed especially for the purpose of reducing the positive plate in the quickest possible time, is composed of dilute sulphuric acid of the proportions of one to five with 10 per cent. of nitrite of ethyl or acetate of ethyl, the nitrite being more active if acidified with not more than 1 per cent. nitric acid, the acetate also with not more than 2 per cent. of acetic acid. If these proportions are exceeded the plate will be dissolved. The two plates or electrodes are immersed in this electrolyte and a current of electricity is passed through them sufficiently powerful to cause a commotion of the solution, it being electrolyzed with a current of from six to ten amperes per square foot of actual positive pole plate, or electrode surface. There results from this action an exceedingly rapid peroxidation of the positive pole plate or electrode in the nature of a coherent hard deposit. An electrode can be peroxidized in this electrolyte in a very brief space of time, whereas with the Planté method and electrolyte of dilute sulphuric acid, days and even weeks are required. It is claimed only one charge is required of one and one-half times to twice the ultimate capacity of the plates. The plates are then removed, washed with water, and set up in the usual electrolyte.

ARC LIGHT REGULATOR.

Patent 393,574 relates to improvements in arc light regulators in which the feed of the carbons or electrodes is regulated or governed by thermal effects and adapts the lamp for use with either direct or alternating current generators of electricity. It is known that arc lamps governed by electro-magnetic regulators, or, in fact, any regulator in which the carbons are in contact when no current is flowing over the circuit, cannot be advantageously used on circuits supplied by secondary batteries, for the reason that the low resistance path offered the current through the carbons creates such intense heat at the point of contact that they become fused together before they can separate, thus preventing the operation of the lamp.

It is the especial object of this invention to overcome this objectionable feature, and also to provide an arc light regulator, which shall be equally well adapted for use with direct and al-

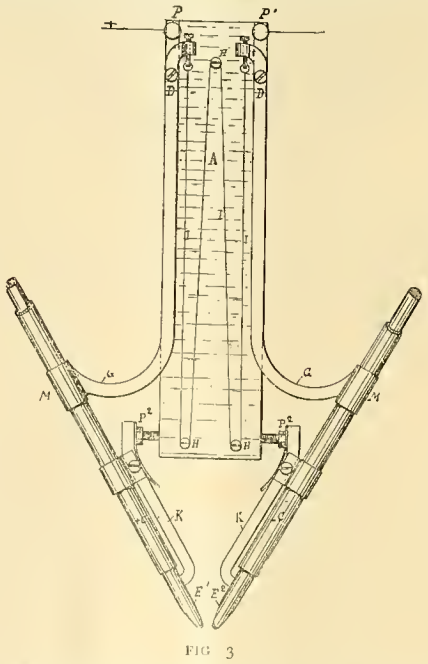


FIG 3

ternating current generators. These objects are accomplished through the agency of a thermal regulator which holds the electrodes normally out of contact when no current is on the line, and allows them to come momentarily into contact after the current has been set up, and then withdraws them, thereby establishing the arc. This regulator consists of a thermal conductor attached to the electrode carriers and constitutes a high resistance shunt to the normally open circuit at the electrode points. With such a regulator the arc can be established and the objectionable feature referred to avoided.

Fig. 3 illustrates a side elevation of a regulator in which only one carbon electrode is fed forward, and Fig. 4 a modified form adapted to feed both electrodes simultaneously.

A is an insulating support or base which carries or supports the several parts of the regulator. B is a metallic bar attached to the base A on the left. At its upper end is a binding post, P, connected to the plus pole of the generator in the usual manner. At the lower end, D, of the bar B is pivoted an arm, G, which carries a hollow carbon-holder, C, in its lower upturned end, M. B' is a metal bar rigidly secured to the support A on the right hand side, and having a binding post, P', at its upper end for connecting it with the minus pole of the generator. The lower end of this bar B' has an electrode holder

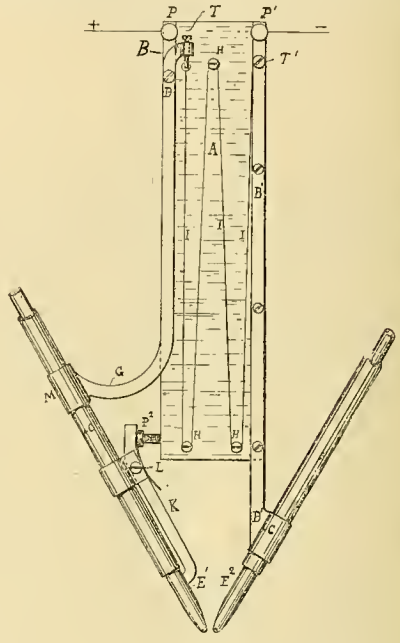


FIG. 4.

and guide, C. E' E² are the electrodes, the former of carbon and the latter, Fig. 3, of non-combustible material—iron, copper, or like material; but in Fig. 4 both electrodes are of carbon or the material generally made use of in arc lights. K is a clutch lever pivoted to the carbon carrier C, its lower end being sufficiently long and heavy to hold the carbon from feeding forward under normal conditions. The flat leaf-spring L is adapted to aid the weighted end in firmly gripping the electrode. P² is a screw adapted to abut against the short arm of the lever K when the arm G tilts to the right. I is a high resistance wire of platinum, attached at one end to the upper end of the short arm of lever G by an adjusting screw, T, and passing thence around pulleys H H H to the upper end of the bar or plate B, to which it is affixed by an adjusting screw, T', for regulating its length.

The operation is as follows: The battery having been connected to binding posts P P', the current passes by plate B, short arm of lever G, to wire I, and thence by plate B' to line. This heats the high resistance wire I, thereby expanding it, causing the lower end of lever G to tilt to the right until the upper end of lever K is brought into contact with screw P², thereby releasing the electrode E' and allowing it to slide forward until it touches the opposing electrode E². Immediately the current takes the low resistance path through the electrodes, and this permits the wire I to cool and hence to contract, thus causing the electrodes to separate and the arc to be established. This operation is repeated when the arc becomes abnormal.

The modified form shown in Fig. 4 differs from that shown in Fig. 3, in that both carbons or electrodes are fed forward, the arm G on the right and its attachments being a duplication of those shown on the left in Fig. 3, the wire I being connected in this instance to the upper ends of both levers G. The wire is preferably so adjusted that it is heated sufficiently to feed the electrodes at a temperature of from 100 degrees to 200 degrees Centigrade, and in practice it is found that the best temperature is about 125 degrees, as the wire appears to be

more sensitive at that temperature to varying changes of current strength, due to the operation of the lamp.

APPARATUS FOR PROPELLING CARS.

Patent 393,572 relates to improvements in apparatus for drawing or driving tram cars and analogous vehicles through the agency of electricity; and its objects are, first, to make the application of electrically controlled power to existing lines of tram cars and analogous vehicles possible without any change in either the rolling stock or its appurtenances, and in such manner as to obtain great efficiency; second, to provide means for the control of the power, which shall be simple, efficient and capable of use for other purposes on the lines where used than the mere propulsion of the cars, as to clear the track of snow or dirt, and in short, to utilize the applied power in numerous ways aside from its mere application as a means of propulsion; third, to provide simple and efficient clutch and

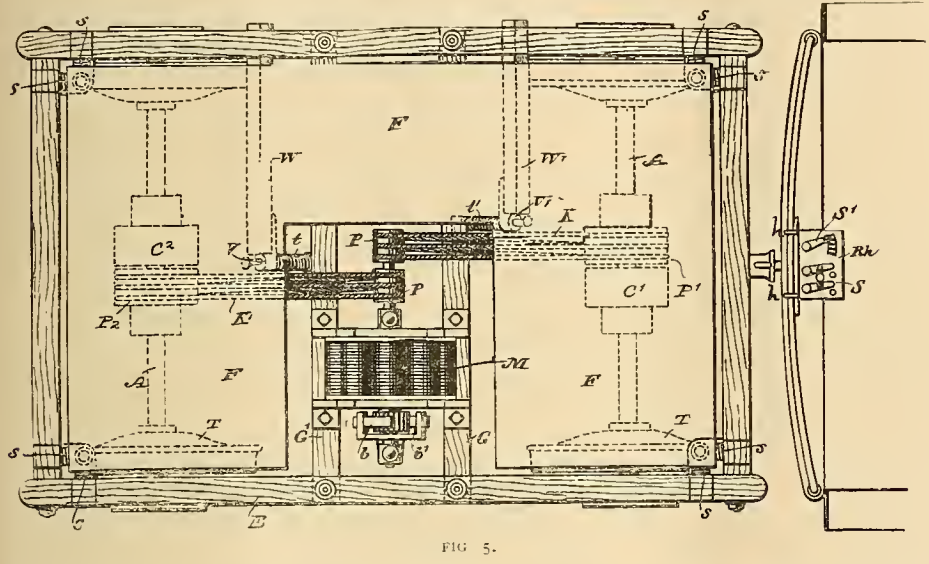


FIG 5.

switch connections for connecting the propelling electrical motor to the motor which moves the car or cars, and also to provide additional means for increasing the security and efficiency of said electrical motor, and the source of electrical supply which gives it motion.

Fig. 5 is a plan view of the car-propelling vehicle, showing the trucks and portions beneath it in dotted lines, a tram car being attached by the usual link connection found on railway cars. Fig. 6 is a diagrammatic view of the clutch and switch mechanism for connecting the electrical motor and battery to the axle or axles of the propelling motor or car.

The invention is especially designed for application of electricity as a motive power in that class of inventions where the source of electrical generation is carried on board the engine which propels or draws the vehicle to be moved.

R, R, are the rails of an ordinary tram car track; T, T, the trucks; A, A, the axles of a dummy or motor-carrying car having a rigid frame, E, E, carried directly by said trucks. Near the middle of this frame is a pair of strong floor timbers, G, G', extending from sleeper to sleeper, upon which is firmly bolted an electric motor, M, the pulleys, P, P, on the motor shaft being located midway between and above the axles, A, A, of the truck wheels, T, T. P' and P^2 are grooved pulleys adapted to run loosely on the axles, A, A, and to receive the ropes or cords, K, K'. Tension pulleys, are supported upon cross-arms, W, W', attached to the sleepers of the car frame, and are adapted to yield to the inequalities which take place in the rope's action by spiral springs, *t*, *t'*, pressing against the heads of the sliding sustaining arms, and also having a lateral adjustment due to swivel connections.

These parts are of course adjustably attached, so as to regulate the pressure of the pulleys upon the cords or ropes. The pulleys, P, P, are attached directly to the armature shaft, while P' and P^2 are journaled loosely upon the axles, A, A, of trucks, T, T. These pulleys, P', P^2, are made of magnetic material, as iron, and are provided with insulated wire bobbins, so wound upon or about them as to magnetize them when a current of electricity is passed through them. C', C^2, are two similar magnetic masses similarly wound with insulated coils, in such manner that they will become magnetic when the coils are electrically charged.

Referring to Fig. 6, the electrical connections of the fixed and loose clutching parts, P', C', P^2 and C^2 being duplicates thereof, the part, C', is rigidly keyed to the axle, A. The ends of coil, *z*, are connected, respectively, to the metallic rings or bands, c^2, c', insulated, as shown, and these bands are connected in turn through brushes, b^3, b^4, to the wires, w^2, w^3, leading to the pole changing switch, S, S, and they in turn are connected at points, p, p^2, to the battery or generator, B, A, preferably a storage battery. Similarly the ends of coil, *z'*, are connected by insulated bands, c^2, c^3, brushes, b^2, b^3, and wires, w', to the poles of the battery or generator. The poles of the motor, M, are connected by brushes, *b*, *b'*, and wires, *w*, *w*, through switch, S', to the poles of the same battery or generator. All of these conductors are preferably inclosed in a flexible cable, H, and connected to a portable switch-board having hooks, *h*, *h*, and carrying the usual rheostat, R, *h*, and switches, S, S and S', for manipulating the motor car.

The switches may be arranged in any desired manner, and a pole switch may be substituted in the well-known manner for S', so as to enable a reversal of the direction of the motor and run the car in either direction.

The portable switch apparatus connected through a flexible cable, H, is hung, as shown,

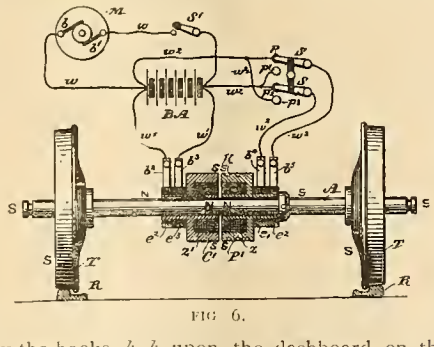


FIG 6.

by the hooks, *h*, *h*, upon the dashboard on the front platform of the first car, so that the attendant can stand on this platform and control its movements. The dummy or motor may be attached to any existing car by simply coupling the connecting links and placing the switch mechanism as shown. It may, in like manner, be attached in the rear of a snow-plow or dirt-sweep.

The operation of the apparatus is as follows:

As shown in Fig. 6 the motor, M, is out of circuit and the loose grip or clutch pulley, P', held away from the face of its opposing fixed part, C', by the repellent action due to the like poles of the magnetic parts, the current through *z* being in such direction as to create a north interior and a south exterior pole, while the interior and exterior poles of C' are always north and south, respectively, by reason of the constant direction of current from battery, B, A. Suppose the switch, S', to be closed. There results a multiple arc branch of the circuit from battery, B, A, by wires, *w*, to the motor, M, and its armature commences to rotate, carrying with it the loose pulleys, P', P^2, under stress of the cords or ropes, K, K'. After the motor has attained a sufficient speed switch, S, S, is reversed, thereby reversing the direction of the current through the coils, *z*, *z*, of the loose magnetic pulleys, P' and P^2, causing them to slide longitudinally on the axles, A, A, in the direction of the fixed parts, C', C^2, thereby clutching the two parts firmly together and imparting motion to said axles and trucks, T, T, of the dummy or motor car. The speed can be regulated in any well-known manner, as by the rheostat, R, *h*.

It will be noticed that by locating the magnetic pulleys, P' and C', P^2 and C^2, upon the axle shafts of magnetic material, as iron, the truck wheels being also of iron, these parts become magnetized, thereby increasing the traction of the engine. With a secondary or storage battery located in the spring-sustained box, B, and this method of uniting the clutching apparatus, and at the same time increasing the traction, a simple and efficient motor for propelling vehicles is provided. The box, B, is made with a bottom, F, F, having an opening at one side and near the center to permit access to the motor, as clearly shown in Fig. 4. It is sustained upon the frame, E, E, against lateral, longitudinal and vertical vibrations due to inequalities in the road by strong springs, *s*, *s*, *s*, at or near each corner, thereby permitting the battery to be carried with a minimum amount of disturbance.

The motor, M, projects above the car floor, and through the battery box, B, so that all of its parts are accessible to the attendant, and it is kept free from dust or dirt.

The Book Table.

THE ELECTRIC MOTOR AND ITS APPLICATIONS. By Thomas Commerford Martin and Joseph Wetzler; published by W. J. Johnston, New York. Second edition enlarged, 282 pages, 10½ inches x 8½ inches. Price $2.50.

This book, as indicated, is an enlargement of the first edition published in 1887. The first twelve chapters are reprinted and four new chapters are added. These four chapters, numbering from XIII to XVI, inclusive, treat of the latest American motors and motor systems (in continuance of Chapter XIII); the latest European motors and motor systems; alternating current motors; and thermo-magnetic motors. As a whole the book is admirable. It is comprehensive, clearly and ably written; thoroughly illustrated, and lastly, is one of the very few works in existence upon the electric motor and its applications. It should have a place in every electrical library.

PREPARING FOR INDICATION. By Robert Grimshaw; published by Practical Publishing company, New York; 56 pages, 5½ x 4 inches. Price $1, post paid

The title of the book is suggestive of the text, which treats of the preparation of an engine for indication. In the preface the author states very truly, that while existing books upon the steam engine indicator are quite full in their instructions about how to take indicator cards, and read them after being taken; "they are very meager in practical directions how to pipe up and hitch on." We believe this book has a place entirely its own, up to the present at least.

New Capital for the Edison Company.

We have it from good authority that the Edison Electric Light company, of which Edward H. Johnson is president, has just obtained $10,000,000 new capital for use in extending the business of its already mammoth manufacturing and local company interests. This money, we understand, comes from Amsterdam, Henry Villard, so well known from his colossal financial operations in connection with the Northern Pacific railroad, being the intermediary. The local Edison company in St. Louis will get some of this money, it is said.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CONTENTS OF THIS NUMBER.

PAGE.
The New Thone Electric Motor, Illustrated 289
Chicago City Electric Lighting 289
Protection and Electric Lighting 289
The Telephone Question in Chicago 289, 290
Lighting & Power Plant at Thorennberg, Illustrated 290
Method for Measuring the Resistance of Electrolytes, by Johann Carl Purthner, Illustrated 291
New Iron Box Bell, Illustrated 291
Paget Storage Battery and Its Applications, Illustrated ..291, 292, 293
Arc Light Regulator 292
Apparatus for Propelling Cars 293
The Book Table 293
New Capital for the Edison Company 293
Editorial 91
Magnetos, by F B Badt 295
A Guard Against Incandescent Lamp Breakage, Illustrated ..295, 296
Lamp Lighting Schedule—Moonlight System—For December 296

DEPARTMENTS.

Correspondence 296, 297, 298
The Electric Light 298
The Electric Motor 298, 299
The Telephone 299
The Telegraph 299
Electrical Patents 300

Notice to Exhibitors.

Manufacturers of electrical apparatus should bear in mind the fact that it is the intention of the Executive Committee of the National Electric Light association to make the Chicago meeting the most notable ever held as far as exhibits are concerned. The committee will not attempt to find room in the limited accommodations afforded by a hotel for the large amount of apparatus which it is expected will be exhibited, but will rent a separate hall provided with power and all the necessary adjuncts, so that there will be plenty of room and unlimited accommodations for all. It rests largely with the manufacturers whether this exhibition shall be the unqualified success for which the committee is working. Every manufacturer should prepare for an exhibition much larger than ever attempted before, and should make application for space early. These applications should be addressed to A. V. Garratt, secretary of the association, at 16 East Twenty-third street, New York, by whom they will be promptly forwarded to B. E. Sunny, Chicago, chairman of the executive committee, under whose direction the arrangements for the exhibition are being carried on. Western applicants, and all others who prefer to do so, can apply directly to Mr. Sunny, at 148 Michigan avenue, Chicago, for space, as all allotments will be made by him.

PROFESSOR BADT talks in an interesting way about magnetos, and gives some curious illustrations of natural, though fallacious inferences from indications of the alternating current magneto. His brief treatise is particularly commended to those engaged in testing.

AN interesting installation is that at Thorennberg, described elsewhere. A water power three miles away is utilized to generate electrical energy to light the town of Lucerne, and to run a flour mill. The alternating current is used to supply the lights, and the continuous current to supply the motor. Our contemporary, *La Nature*, does not give the installation its due credit, however, as since the article was written, a new 5,000 light Zipernowsky alternating generator has been put in to supply the increased demand for light.

THE Chicago city council and the Chicago Telephone company have declared war. Thus far the company has had the best of the fight. The council, however, proposes to petition the legislature for means to enable the aldermen to humble the company. It is exceedingly unfortunate that a compromise could not have been effected. The outcome of the controversy will be awaited with great interest throughout the country. Meanwhile, many citizens of Chicago will be deprived of telephone service, as the lines cannot be extended.

THE electric motor for mining operations is found to be a success. At the Nevada sixty stamp quartz mill near Virginia, Nev., the electric motor has been recently tried with the most gratifying results. It is now proposed to utilize a water power sixteen miles away by placing generators at the source of power and conveying electrical energy to the points where it is desired by conductors. The adoption of this plan will enable stamp mills to profitably work a low-grade ore that is now thrown away.

IN another column a gentleman identified with electric lighting sets forth in an interview his ideas on the question of the protection of local companies by corporations which have sold them plants. His ideas are worthy of the consideration of those connected with this interest. He asserts that local concerns not infrequently have practically lost their entire investment through the sale to a city of a new plant. He urges the coöperation of the selling corporations, and predicts that the question will come up for consideration at the convention of the Electric Light association.

A PROMINENT electric light company, according to report, has recently secured ten million dollars new capital, which, added to its already great investment, will give it a truly colossal aggregation of capital.

Much has been written of the steady advance of electric light interests, and many promises have been made by electricians of the future of the electric light. A better indication of the material prosperity of this comparatively new industry than that contained in the opening paragraph could not be desired.

Conservative capitalists are slow to invest unless they feel sure of returns.

EVERY few days an electrical genius bobs up and announces that he has discovered a new application of the primary battery to the generation of electricity for lighting or power purposes, and more or less furore—generally less, on the part of electricians—is awakened by the announcement.

The application of the primary battery to electric lighting is a matter of history of years. Commercial electric lighting waited until the dynamo, as a cheap generator of electricity, was invented, and since then its progress, especially of late years, has been amazing.

It will not do for any electrician to state that the primary battery never can be applied economically to electric lighting or power purposes, for the limits of the galvanic battery are not known, even yet. But the consensus of experience is that primary batteries of to-day have a clearly defined field entirely their own, and the generation of current for electric lighting and power is not within that field. Francis B. Crocker, in a paper read before the American Institute of Electrical Engineers, and printed in No. 21, Vol. II, of the WESTERN ELECTRICIAN, so clearly sets forth the limitations of chemical generators that we are constrained to quote: "I am by no means a skeptic in regard to chemical generators of electricity; the possibilities are very, very great. * * * But when it comes to developing any considerable amount of actual power, then the limitations become apparent. When we remember that battery electricity will certainly cost in practice 50 cents per horse power hour, since the materials alone cost 25 cents, and that dynamo electricity only costs 2 cents per horse power hour, the claims of some primary battery electric lighting promoters show up in their true light."

PROF. ELISHA GRAY is confident that his telautograph will have a successful future. His last experiments have, he says, demonstrated beyond all question its practicability. He is quoted as saying: "I expect the invention at once to supersede the telephone where accuracy is required and over long distances. It will also be taken up immediately as an adjunct to the telegraph in the transmission of messages involving monetary transactions. It can make no mistakes. It tells at the other end just what you write, word for word, and line for line. No operators or third parties intervene as interpreters between the two pieces of paper. They stand as fac-simile records, in the hands of transmitter and receiver, of what has passed between the parties."

LONDON is now confronted with the same problem that has proved such a source of vexation to the authorities of New York—the question of overhead or underground wires. The extensive projects for lighting the metropolis by electricity have caused a discussion of the question, and the London *Standard* has sounded the alarm. The London *Electrician* says that while it is anxious to see the experiment of underground conduits for all kinds of conductors tried on a considerable scale, "yet we cannot wish to see the progress of electric lighting delayed because of the few additional housetop wires which it would involve."

Naturally the eyes of the English turn to this country, where such splendid efforts have been made to secure a satisfactory solution of the vexatious problem. The *Electrician* is inclined to believe that action in New York in the matter of compelling companies to bury their wires, has been too precipitate. It does not think that the same necessity for burying wires will exist in London, for the reason that it assumes that the lines will never be maintained in an unsafe condition. The explosions in the conduits in New York and Boston are referred to, and similar explosions in Chicago might have been alluded to, as troubles attending the burying of wires. The importance of the explosions has been, however, generally over-estimated. They have been few and far between, and they have been by no means as terrific as one might believe from reading the descriptions of them. The *Electrician* closes its article as follows: "More than 100 miles of overhead electric light wires are already working in London alone, and there has been no serious accident traceable to bad workmanship, carelessness, or want of supervision. The board of trade can be trusted to frame and enforce regulations sufficiently strict; and with this guarantee the public may be content to allow the necessary erections for any electric light supply that London will require for some years to come."

Every one will desire success to attend the efforts of those who are making such an extensive installation in London. However well the lines are built, the projectors will soon find strong opposition to their continuance overhead. It cannot be denied that the prejudice against the overhead system is growing in American cities, and the few explosions do not modify public opinion in this particular. One cannot avoid expressing the hope that the London system will be so built that the necessity will not arise within a few years for an entire remodeling of the circuits.

Magnetos.

BY F. B. BADT.

An instrument extensively used for various purposes is the magneto. This word has caused, and probably is causing, a good deal of trouble to German and French scientists, who generally find it a stumbling block in their acquirement of a knowledge of the English language. In an otherwise excellent German book, published only a few weeks ago, I find, for instance, magneto translated as magnet-nadel-instrument, (magnet-needle-instrument). In order to help our foreign contemporaries we will try to give a definition for magneto, which they will readily understand.

A magneto, as the term is generally used in this country, applies to a small magneto electric generator with a Siemens double T armature, without a commutator, revolving between the poles of steel magnets. The little armature is set in motion by hand and generates alternating currents of very high e. m. f., which will set a polarized bell to ringing when the circuit is closed.

This magneto is very advantageously used as a call for telephones, but unfortunately it is also used as testing instrument, especially in electric lighting installations.

Although various writers have shown, from time to time, how unreliable an instrument for this purpose the magneto is, it is still being used on an extensive scale. It has been pointed out innumerable times that this magneto will give false rings under certain conditions, and mislead the person who is testing.

One day a man came to me in great excitement, stating that the field wire of a large shunt-wound dynamo was broken, as the magneto would not ring through the field circuit. I showed him, however, that one galvanic cell would deflect the needle of a detector galvanometer, and that the circuit was not broken. It was, of course, beyond the man's comprehension that the self-induction of the large electro-magnet was sufficient to retard or choke the alternating current of the magneto, and prevent the bell from ringing.

In another instance an arc light line was tested for grounds. The weather was perfectly dry, the whole line consisted of *well* insulated wire (*not* underwriters') fastened to glass insulators, still the magneto would ring lustily through earth. A test made with a Wheatstone bridge galvanometer and thirty chloride of silver cells showed the insulation of the line to measure above 1,000,000 ohms. By means of a wet thread the insulation of the circuit was lowered to about 50,000 ohms, and a test with the magneto then indicated no grounds. The electrostatic action of the well-insulated line caused the false ring.

The question now arises, "Is the magneto the testing instrument we desire in the hands of engineers, dynamo tenders, linemen, etc.?"

The question, of course, must be answered in the negative. But what shall we give them? A testing apparatus for these men should fulfill the following conditions:

1. It should be cheap.
2. It should be compact and portable, and stand rough usage.
3. It should be reliable, and its indications should be easily understood.
4. It should indicate through at least 15,000 ohms' resistance.

There is no testing set, consisting of galvanic cells and galvanometer, which will come up to these requirements, and we therefore advise, until something better is found, as a mere make-shift, a *direct* current magneto.

An alternating current magneto can very easily be changed to a direct current magneto by putting a two-segment commutator on the armature. The polarized bell, of course, cannot be used in connection with this magneto. A high resistance buzzer may be put in the box, or a high-resistance detector galvanometer may be used in connection with the magneto. The indications of this kind of a magneto will be reliable, and not mislead our working men.

In addition, the direct current magneto can be used to find out the direction of the current, which is very often desirable, for instance, on arc light circuits, to see whether the arc lamps are hung in the right direction or not.

A Guard Against Incandescent Lamp Breakage.

Edward H. Johnson of New York, assignor to the Edison Electric Light company of the same place, is a recipient of one of the patents issued November 27th. The specification sets forth that when incandescent electric lamps are used in series with one another and with currents of high tension, and provided with cut-out devices of the ordinary kind for closing a shunt around each lamp when its carbon breaks, difficulty arises in the following way: If the carbon breaks, so that the current cannot pass through it, the high tension current is apt to pass across the vacuous space within the lamp globe from one side of the carbon below the point of breakage to the other side, forming an arc. This passage being provided for the current, the cut-out fails to act, and the arc therefore continues and follows down the carbon and the leading-in wires to the inner stem, which, being heated, becomes a conductor, and the arc or current then passes through the glass to the wires within the stem, and so on down to the socket and cut-out mechanism, so that the lamp, socket and cut-out are all destroyed, as well as the continuity of the circuit.

The object of the invention is to provide means for stopping the arc when such occurs before it leaves the lamp; and to this end the invention mainly consists in placing the wires outside the vacuum globe, such wires being insulated from each other so close together that when the arc reaches the point where the wires are so placed their fusion by the heat of the arc will cause them to be fused or soldered together, whereby a good connection is made between them and circuit is closed around the carbon of the lamp, so that the series circuit is completed to the other lamps independent of the cut-out, the device forming an automatic cut-out, whose operation is effected by the arc itself.

To insulate the wires from each other, the inventor prefers to employ upon one or upon each of them a thin covering of cotton or similar fabric, which becomes carbonized by the heat of the arc, and thereby assists in forming a good electrical connection between the wires. Both wires may be inclosed in a small tube of lead, tin, or other readily fusible metal which will melt, and itself act to solder the wires together. The wires are preferably twisted together for a short distance within the glass tube or stem; but they may instead be simply placed side by side, and if necessary held together by the tube placed around them, or by any suitable wrapping or binding.

When the lamps constructed substantially as described are connected in series, the inventor prefers to employ in connection with each lamp electro magnetic cut-out mechanism, so that if the carbon breaks without any arc being formed across it, which often occurs, such cut-out mechanism will act to close a shunt around the lamp, and complete the series circuit.

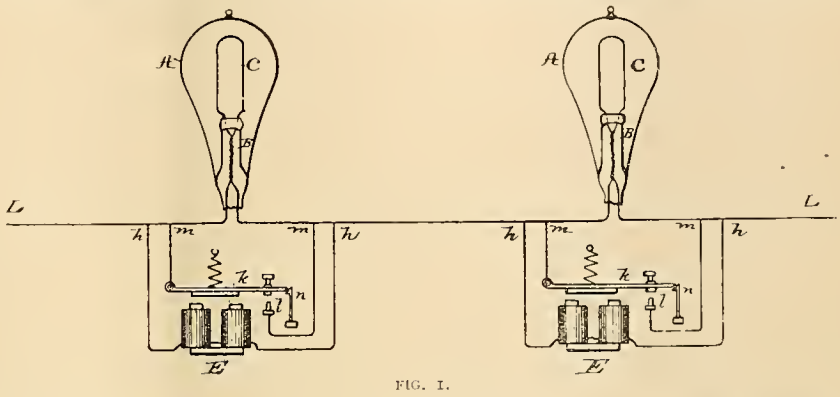

FIG. 1.

Fig. 1 is a diagram of a portion of an electric lighting system embodying the invention; Fig. 2, a view of a lamp with wires twisted together; Fig. 3, a larger view of the inner stem of this lamp after the arc has been formed and stopped; Fig. 4, a view of a lamp in which a metal tube is placed around the wires, and A is the sealed inclosing globe of an Edison incandescing electric lamp. B is the inner tube or stem, through which pass the leading-in wires, *a*, *a'*, such wires being sealed in the glass of the stem at *b*. C is the carbon filament, which forms the incandescing conductor. It is secured at *c*, *c'*, to the leading-in wires in any well-known or desired manner, preferably by electro-plated joints. The lower end of the stem is closed by a cork stopper, *d*, which keeps the wires in place. In the form shown in Fig. 2 the wires, *a*, *a'*, are twisted together in the tube, B, as shown at a^2, so as to bring them close together for a considerable portion of their length. One or both of these wires are covered with insulating material, *e*, which insulation is a light one, preferably of cotton or other carbonizable material, which will act in the manner already explained.

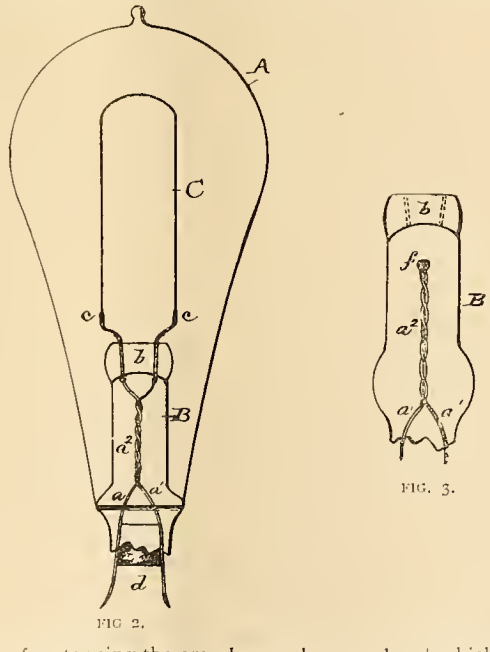

FIG 2. FIG. 3. FIG 4.

Fig. 3 shows the stem after the arc has been formed and stopped, the wires, *a*, *a'*, down to the

point at which they were twisted together, having been consumed by the arc; but at this point they are soldered together, as shown at *f*, by the fusion of the metal, and the circuit is therefore closed around the carbon, as has been set forth.

In the form shown in Fig. 4 the insulated wires are simply placed side by side in contact, and are inclosed by a tube, *g*, of lead, tin, or other readily fusible metal. The operation or effect of this arrangement has already been clearly explained, the metal tube melting and assisting to solder the wires together.

In connection with the lamps constructed as described the inventor prefers to employ a suitable electro-magnetic cut-out device, which may be such as is shown in Fig. 1. In this figure, L, L, is the line circuit, in which any suitable number of lamps, A, are placed in series. Around each lamp is a shunt, *h*, *h*, including the coils of an electro-magnet, E, whose spring-retracted armature lever, *k*, is adapted to make and break at *l* another shunt, *m*, *m*. When the carbon filament breaks, if an arc across the filament should not be formed the magnet, E, is energized, and its armature lever closes circuit, *m*, *m*, around the lamp, so as to maintain the line circuit to the other lamps. The catch, *n*, locks the lever down upon *l*, so that the shunt is kept closed until the broken lamp is replaced by a new one, when the catch is withdrawn by hand, and the armature lever is brought away from contact by its spring.

The invention thus provides for both of the two contingencies which arise in the use of lamps in the manner explained. If the carbon breaks and no arc is formed, the electro-magnetic cut-out closes circuit around the lamp. If the arc is formed, it itself causes a short circuit within the stem of the lamp.

Lamp Lighting Schedule. — Moonlight System.

DECEMBER.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**5.00**	6.10	13.10
2	**5.00**	6.10	13.10
3	**5.00**	6.10	13.10
4	**5.00**	6.10	13.10
5	**6.10**	6.10	12.00
6	**7.20**	6.10	10.50
7	**8.20**	6.10	9.50
8	**9.30**	6.10	8.40
9	**10.30**	6.10	7.40
10	**11 40**	6.10	6.30
11	12.40	6.10	5.30
12	1.30	6.20	4.50
13	2.30	6.20	3.50
14	3.30	6.20	2.50
15	4.30	6.20	1.50
16	No	light.	0.00
17	No	light.	0.00
18	No	light.	0.00
19	**5.00**	**6.50**	1.50
20	**5.10**	**7.40**	2.30
21	**5.10**	**8.40**	3.30
22	**5.10**	**9.40**	4.30
23	**5.10**	**10.40**	5.30
24	**5.10**	**11.50**	6.40
25	**5.10**	12.50	7.40
26	**5 10**	2.00	8.50
27	**5.10**	3.10	10.00
28	**5.10**	4.20	11.10
29	**5.10**	5.40	12.30
30	**5.10**	6.20	13.10
31	**5 10**	6.20	13.10
Total number of hours,			228.00

The foregoing schedule is practically good for the United States. The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

It is said that one of the most interesting objects at the forthcoming exhibition in Paris will be a huge traveling crane in the machinery hall. The crane will run throughout the whole length of the hall, and will be worked by electrical means. It will be used during the work of installing the exhibits, for lifting and putting down heavy pieces of machinery, and after the exhibition is opened the crane will be fitted with a platform for passenger accommodation, and will be utilized to carry visitors from one end of the hall to the other. It is rumored that a new company has been formed for the purchase of the Eiffel tower. The new company will not take the tower over immediately, but only after its completion.

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 28.—The public test of the Daft motor on the Ninth avenue elevated road, Monday night, was so successful in every respect that the result was exceedingly gratifying to the inventor and his friends. Mr. Daft managed the motor in person, and although the weather was rainy it handled the three cars laden with guests in the most satisfactory manner, winning a compliment from Colonel Ham, the manager of the Manhattan elevated system, who said he considered the trial a complete success, although the time made was a little slower than that of the steam locomotives. This he was sure could be improved upon. He remarked rather significantly that electricity was undoubtedly the coming power. The motor "Benjamin Franklin" used in the trial weighs eight tons, or only about half that of the locomotives, and is rated at 125 horse power.

In the Supreme court on Tuesday the United States Illuminating company endeavored to procure an injunction restraining the Board of Electrical Control from compelling its wires to be placed in the conduits. President Hess was the only member of the board present, although his colleagues and many other gentlemen were well represented by affidavits. A mass of affidavits was presented, in which the opinions of experts were conflicting, and apparently tinged by their relations with the principals in the suit. Judge Lawrence did not seem to have a very high opinion of the value of experts' affidavits, and leaning back, with a sigh of resignation, he said: "Read away, but you might as well read the advertisements in the *Law Register*." The Illuminating company strives to prove mainly by its affidavits that no subways have yet been put down that are suitable for the accommodation of its wires. The company also complains of corruption, and partially on the part of members of the board. It is charged also that the Brush, East River, Mount Morris and Harlem companies have been permitted to string new wires overhead, and that members of the board, or their friends, are interested in one or more of those companies; and that, in fact, the whole subway business is a gigantic job, in which the Western Union, the Metropolitan Telephone company and Maurice B. Flynn are concerned. Judge Lawrence objected several times to being placed in the position of an electrical expert by such testimony. He said that it appeared to him the real question was whether the Board of Electrical Control had acted illegally in ordering the Illuminating company to place its wires under ground. "Why," said he "these experts always differ. Only a few years ago I tried a case, in which plenty of experts swore that no underground conduits could be constructed in which electrical wires could be operated. Now their ideas have progressed, so that all the experts admit that conduits for telephone and telegraph wires are all right." The commissioners were well fortified with affidavits by William Maver, jr., electrician Western Union; Prof. John P. Barrett of Chicago, J. Elliott Smith, superintendent of the New York Fire Alarm telegraph, and many others. Leonard F. Beckwith, who was in attendance, said that the conduits of the Western Union company, as well as those of the Conduit company, were affected by the steam heat.

John A. Secor's yacht, Eureka, was launched in Brooklyn on Tuesday. She is to be propelled by his new method of propulsion—the explosion of atomized petroleum ignited by electricity. The motive power is applied directly to the water through pipes at the bow and stern, and is due to the expansive properties of oil gas. The cylinder, or pipe, at the stern is 10 feet long and 20 inches in diameter, and is constructed to stand a pressure fifty times in excess of that produced by the heaviest possible explosion. The apparatus is automatic, excepting in the use of electricity for ignition.

The fight over the street lighting in Brooklyn has been renewed, a proposition having been introduced in the board of aldermen looking to the erection of ninety extra arc lamps on Clinton and Henry streets, which was opposed on the ground that there were no funds for that purpose. There are now 10,357 gas and 1,045 electric lights in the streets, the aggregate cost for which is $408,160.58. The board of estimate appropriated $480,000 for street lighting last year, and it is alleged that the Citizens' Electric Illuminating company is anxious to bag the excess of $70,000.

The Police commissioners of Newark, N. J., are seeking light in regard to the adoption of a police patrol signaling system. At the meeting last Saturday night there was an exhibition of the J. C. Wilson municipal signal of Boston, and which is used in that city. It was thought that the apparatus was rather complicated, and not equal to the telephone for similar purposes. P.

Sacramento, Cal.

SACRAMENTO, CAL., November 21.—Yesterday was a great day for Sacramento, as it saw the successful introduction of electricity as the motive power for propelling street cars. Ever since a few energetic and enterprising business men entered upon the construction of a street railway on which electric cars were to be used, the city has been heard on all sides that it never would be a success, and everything possible has been done by some people to belittle the efforts of the managers and throw cold water on the enterprise. Yesterday the officers and promoters of the scheme had their day of victory and received a perfect ovation from the populace as they passed through J street on their elegant car. It was the occasion of the trial trip of the first car, and it proved a success in every particular.

The car is propelled by two electric motors of four horse power each, capable of working up to eight horse power each. The motors are actuated by electrical energy stored in eighty cells of the Electro Accumulator company's make (type "23c"), which are carried under the seats of the car. These cells are run under the seats from the end of the car upon trays, and make the connection with the machinery of the car automatically. The weight of the eighty storage batteries, together with the two motors and all other electrical apparatus and machinery, is 5,000 pounds. The car itself weighs 5,500 pounds,

One o'clock yesterday afternoon was the hour set for the trial trip, and neatly printed invitations had been sent to the following gentlemen to occupy seats in the car: Governor R. W. Waterman, F. R. Dray, James Armstrong, of San Francisco, Frank Miller, S. Prentiss Smith, B. U. Steinman, P. S. Lawson, president of the Pioneers; Joseph Steffens, president of the Board of Trade; F. F. Tebbets, president of the Board of Supervisors; R. S. Carey, Rev. H. A. Mayhew, A. Abbott, Eugene J. Gregory, mayor of Sacramento; Trustee John Ryan, Trustee H. C. Wolf, J. R. Watson, W. W. Douglas, C. S. Marquandt of Des Moines, Ia.

The invited guests were assembled at the corner of Fourth and J streets, and had but a few moments to wait for the car, which started from the end of the line near the Southern Pacific passenger depot. As it came around the corner of Third street, and turned into J, a great shout went up from the hundreds of people who were collected along the sidewalks on both sides of the latter thoroughfare. Stopping at the corner of Fourth, the favored individuals who held invitations were taken on board, and the car moved on up J street. The electrician, Mr. Wright, stood on the front platform with his hand on the little lever by which the car is started and stopped, and its speed regulated.

Those on the car were delighted. Stops and starts were made without the least jerk or jar, and the car ran with less noise than the ordinary horse car. At the street crossings the electrician sounded the gong by simply pressing an electric button with his foot.

The late rains had put the streets in a terrible condition, and as no car had ever been run over the track, some difficulty was anticipated, but none was experienced.

The return trip was made without the slightest hitch. The car is not turned round in order to run back. The lever is simply removed from one platform to the other, the headlight changed to the other end, and the action reversed. Most of the trip was made at a low rate of speed, owing to the condition of the track, but coming down J street the car ran at the rate of fifteen miles an hour, making a block in twenty seconds.

At 7:30 o'clock in the evening the car was brought out again and made four trips up and down J street as far as Eleventh, carrying the wives and families of the directors of the road. The appearance of the car at night was much more striking and attractive than in the daytime. It was brilliantly lighted with electricity, and the electric headlight seemed more powerful than that of a locomotive. The people on the streets were delighted and gave expression to their joy in frequent cheers. The rate of speed at night was greater than during the trial trip and everything worked perfectly. McC.

Kansas City, Mo.

KANSAS CITY, Mo., Dec 1.—Notice has been given that there will be a meeting of the stockholders of the Kansas City Electric Light company at the company's office, on Monday, the 17th day of December, for the purpose of voting upon the proposition of issuing the mortgage bonds of the company to the amount of $100,000, payable in ten years from their date, and to bear interest at the rate of 6 per cent.

W. B. Grimes, in behalf of the Kansas City & Edison Electric Light company, has purchased for $14,000 two lots adjoining the present plant of that company. It is the intention of the company to enlarge the present plant to a capacity of 5,000 incandescent and 2,000 arc lights

and $120,000 will be expended in the machinery for the Edison light in the new building.

W. B. Grimes, chairman of the citizens' committee on the Delaware and Main street loop question, states that the Independent Loop company is gaining in popular favor, and all the stock of that company is provided for in case they get a franchise. Eastern capitalists have submittted a proposition of using electricity as the motive power for the cars on the loop. A.

St. Louis, Mo

St. Louis, December 1.—The telephone company has to make a good many explanations just now on account of the case that is pending in court between the company and city. When the ordinance reducing the price to $50 a year was taken into court, the company and the merchants agreed that the company should make contracts for three months at the rate of $50 a year, and if the company won the case the merchants should pay rent on the basis of $100 a year. Many of the three-months contracts have expired, and now some of the merchants do not know whether to sign similar contracts for another three months.

In the early part of last spring, when the question of rapid transit on street railways was being discussed, it was stated by the management of the Missouri railway that the system of electric propulsion would be adopted on the Laclede line as soon as it was practically demonstrated that electricity could be employed with success for this purpose. The managers of the line have at length become convinced by the success of roads in operation by this power in other cities, that the time has come when it will be feasible to employ this mode of operation exclusively on their Market street and Laclede avenue lines. C. P. Maffitt, president of the road, stated that the system of overhead wires for the transmission of the current along the line had been decided upon, and that either the Sprague or Short system would be adopted; the change of motive power is to be made on the extension of the Market street line from Grand avenue to Tower Grove station The change will afterward be adopted also on the Laclede avenue extension to Forest Park, to be followed shortly by a general change on the whole line. A bill has been prepared by Mr. Maffitt, which will be presented to the council and he hopes to have it passed by next January, when the proposed change will be immediately commenced. In the event of the passage of the bill, a power house will be erected, either at the Laclede avenue stables or at the intersection of Manchester road and Chouteau avenue; the building to be a substantial one, and the whole plant to cost a considerable sum of money. Mr. Maffitt stated that he is not too well satisfied with the cable system, and that while he does not consider the present system of applying electricity by any means perfect, still he regards it as preferable to the cable system as a motive power. The overhead system, he stated, is generally considered the best, and that it is claimed that no danger is to be feared from it. Mr. Maffitt went on to say that he feared the council might decide to wait until after the conclusion of the experiment now being made by Mr. Pepers with electricity on the Broadway line.

A meeting was held by property owners along Chouteau avenue, west of Jefferson avenue, recently, to take action in relation to extending the Lindell Railway company (blue) line to Forest Park, from the stables to the park by electricity. The chairman stated the object of the meeting was to take action regarding extending the Blue line to Forest Park. Mr. Baunhoff was called upon and stated the Lindell Railway company was in real earnest to build the extension to the park, and would have the road in running condition by May or June, 1889, if the "west enders" would assist them. The company has applied for a franchise, and as soon as it was granted would commence to build. The meeting was a very earnest one on the part of the property owners, and the company. This road if built, it is urged, will be one of great interest to business men along Chouteau avenue and west of Jefferson, and the line will be one of the shortest and most direct to the park. P.

St. Louis, Mo., Nov. 29.—The Missouri Electrical society recently held its first regular meeting. The society has fifty members, and will have very interesting meetings during the winter. President Harris has originated novel plans for the winter's work. Among them is a query box, and a series of lectures and experiments by an instructor, who will explain current electricity, magnetism, induction, measurement, frictional and thermal electricity, in the order they are named. The instructor will have a laboratory, which will be equipped with all the necessary instruments and apparatus to make the experiments required to thoroughly explain all the phenomena connected with electricity. The society will install a battery of accumulators to light its rooms and to supply current for experiments.

The Broadway car line has its electrical plant for operating a portion of its road by electricity as an experiment nearly completed. The Short system will be used.

G. J. Percival has sold an incandescent plant for Petersburg, Ill. The Hawkeye system will be used. B.

Louisville, Ky.

Louisville, Ky., Nov. 29.—Louisville's electric street railway will soon be completed, and every one here is awaiting its operation with much curiosity. The line will be about three miles in length. The system to be used is the Thomson-Houston. The power building, containing two dynamos, two engines of 150 horse power each, two large boilers, in fact, two complete plants, in order to avoid delays in case of an accident of any sort, will be located at Seventeenth and Walnut streets in a large and substantial building now in course of erection. The current will be transmitted to the motors on the cars by an overhead wire. The new line will be an experiment, but if it should prove satisfactory, it is the design of the Central Passenger Railway company, which is building it, to extend the system to other streets, and replace mules with lightning. The streets of Louisville are level and straight, and well suited to the electric system, A.

Kentucky Notes.

Louisville, Ky., Nov. 29.—The owners of the Louisville and Evansville Mail Line steamers are arranging to have all their boats lighted with electricity. This method of illumination is now in use on several boats, and has proven so satisfactory that it will be adopted on all.

C. C. Curtiss, general agent of the Brush Electric company of Cleveland, is at the Galt House, and has made a large number of contracts in this vicinity, including M. Muldoon, Ohio Falls Car company, New Albany Woolen mills, and De Pauw Glass works. A.

Newport, Ky., Nov. 30.—The Newport Electric Light company is negotiating for an electric light plant suitable for the requirements of this city. K.

Elizabethtown, Ky., Nov. 30.—An electric light tower is much needed in Elizabethtown. Perhaps no other appropriation of a similar amount of the city's money could yield greater results for general satisfaction or more benefits than several hundred dollars invested in a grand tower with about four lights to illuminate the whole town, and every road leading from it for nearly two miles. A number of the most prominent citizens are urging the enterprise. A.

Winchester, Ky., Nov. 30.—The new electric light system at this place has proved very satisfactory. The plant will be enlarged, and hereafter the whole town will be lighted by that means. M.

Paducah, Ky., Nov 29.—The city is making preparations to light all the principal streets by electricity. Copper wires insulated with asbestos are being put up. The new system of lighting is meeting with great favor, and is considered quite an element in Paducah's progress. L.

Maysville, Nov. 29.—There is a movement on foot to light the streets of the city throughout by electricity. The city council favors the plan, and it will probably be put through. T.

Paris, Ky., Nov. 29.—The city council has contracted with the Gas company to light the city for one year at $3,300. The offer made by the Electric Light company was $1,200 less on the face of the returns, but the councilmen state that the city's stock in the Gas company being worth $13,000, the dividend coming to the city makes the Electric Light company's offer only $240 less, while only 23 large lights would be furnished. Those who voted against the electric light claim that this number of lights would not illuminate the city sufficiently. S.

Cynthiana, Ky., Nov. 29.—Stewart & Altenberg, who have just completed the installation of the Edison light plant in Winchester, Ky., have written the council in this city, asking them to visit Winchester and see how well they lighted the place. They want to light Cynthiana the same way Their proposition will be considered at the next meeting of the council. H.

Indiana Topics.

Crawfordsville, Ind., Nov. 29.—The city council has amended its contract with the electric light company, so that hereafter the lamps will be lighted whenever it is dark, without any reference to the moon. M.

Lafayette, Ind., Nov. 29.—Suit has been brought in the Superior court of Lafayette by Alonzo Platt against the Electric Street railway for $10,000. One of the electric cars ran into Mr. Platt's wagon, severely injuring him This is the second suit brought against the company since it commenced business a month or two ago. P.

Greencastle, Ind., Nov. 29.—The Greencastle Electric Light company has sold its entire plant to G. T. Stewart and Chas. J. Watts of Springfield, O., who will increase the capacity of the works, and otherwise improve the property. A.

The Southwest.

Carthage, Mo., Dec. 1.—Articles of incorporation have been filed of the Carthage Electric Light & Power company, with a capital stock of $30,000, W. B. Myers, T. J. Rittenhouse and Charles J. Myers being the incorporators. A new plant is being erected, rendered necessary by increased demands of patrons. Y.

Joplin, Mo., Dec. 1.—Oliver Moffett is getting matters in shape at the falls for the removal of the electric light plant to that point. N

Kansas City, Kan., Dec. 1.—Benjamin Friedburg of the Consolidated Electric Light & Power company has obtained a temporary restraining order from the probate judge to prevent the Kansas City, Mo., Electric Light company from erecting poles of a certain kind along the south side of Minnesota avenue. The plaintiff, in a petition to the court for an injunction, says that the company is engaged in the construction of works for the manufacture and generation of electricity for lighting the streets of Kansas City, Kan., under the provisions of a franchise obtained from the mayor and council. The injunction is asked on the ground that the defendant company and the Western Union and Pacific Mutual Telegraph companies are operating without franchises from the council, and that for the purpose of obstructing the new company poles forty feet high have been erected along Minnesota avenue, the poles being the same height as those being erected by the new company, thus making it necessary for the plaintiff to use higher poles or suspend the work E.

Eldorado, Kan., Dec. 1.—The Eldorado Gas & Electric Light company has been incorporated. The capital stock is $75,000. The directors are C. H. Malin, H. A. Malin, W. J. Robbins, H. W. Johnson and H. Llewellyn Jones. M.

Topeka, Kan., Dec. 1.—The governor has decided to submit to the legislature the question of the purchase of a full electric light plant for the Capitol building, the gas bills reaching enormous proportions. Especially is this so during sessions of the legislature. R.

Missouri Valley, Ia., Nov. 29.—The Missouri Valley Electric Light company, which has an accumulator station, will increase its capacity by 100 lights. E.

Salina, Kan., Nov. 29.—The Salina Electric Light & Power company will increase its plant by from 250 to 500 lights, using accumulators. O.

Little Rock, Ark., Nov. 29.—The long and tedious contention between the Bell and the Pan-Electric Telephone companies in this city was brought to a lasting conclusion last week by the destruction of the Pan-Electric instruments. By order of the Federal court 1,229 instruments were collected and conveyed to the suburbs of the city and burned. The bonfire destroyed property to the value of $15,000, for which the investors get no return whatever. G.

St. Joseph, Mo., Nov. 29.—An eastern syndicate composed of gentlemen financially interested in the Sprague Motor company has obtained options on the Union Electric Street railway, the Wyatt Park Electric line, the Frederick Avenue line and the Citizens' line for one month. It is the intention to operate the four roads by electricity from one central power house. The Frederick Avenue and Citizens' lines are now operated by horse power. The four roads can be bought for $70,000. E.

Topeka, Kan., Nov. 29.—The Kansas Phonographic company of Topeka has been granted a charter; capital stock, $312,500; directors, Simon S. Ott, George E. Tewksbury, H. P. Dillon, P. I. Bonebrake, R. B Gemmell and A. B. Poole, all of Topeka, and Hamilton S Wicks, of Kansas City, Mo. The purposes for which this corporation is formed are to use, purchase, sell, rent, lease and sub-lease, in the state of Kansas and the territory of New Mexico, all graphophones and phonograph-graphophone patents of Thomas Alva Edison, Alexander Graham Bell, Chichester A. Bell and Turner Tainter, together with all improvements, etc., now or hereafter controlled by the North American Phonograph company. R.

Illinois Items.

Petersburg, Ill., Nov. 29.—Electric lights are burning in this city for the first time. The plant was put in by Chas. D. Wright, a local electrician, and works successfully. G.

Decatur, Ill., Nov. 28.—The Decatur Electric Street Railway company has been incorporated, with a capital stock of $100,000, and has given notice that it will petition the council for leave to operate. The horse car company

opposes the scheme, and partisans of both companies are carrying on a controversy in the newspapers. The new company proposes to have its lines in operation by July 1st.

E.

New Albany, Ind.

NEW ALBANY, Ind., Nov. 29.—The Citizens' Electric Light company has already put incandescent lights in one of the business houses of this city, and if the experiment proves successful will put in others. Thus far nothing has been used here except the large arc light, but the company will, if the proper encouragement is extended, provide an additional dynamo, and will then be prepared to furnish the incandescent light to business houses and residences.

A.

Pittsburgh, Pa.

PITTSBURGH, Pa., December 1.—The members of the Department of Awards visited the plant of the Westinghouse Electric Light company last week, where was given an exhibition of the apparatus for street lighting by the companies, with the exception of Booth & Flinn, which have bid to light the city's streets. Exhibitions were given of the powers of gas, gasoline, oil lamps, electric lights and arc lights. From the remarks dropped by several of the dozen or so persons present, electric light seemed to have great preference.

S

Cincinnati, O.

CINCINNATI, O., December 1.—The special committee of councilmen on electric lighting met last week. The general ordinance for electric lighting was before the committee. Mr. Mullen renewed the motion of Mr. Glenn, made at a former meeting, to charge all electric light companies two and a half per cent., of one per cent., on the gross earnings, but it was evident that no agreement could be had at this meeting, so the subject was laid over until a full attendance of the special committee can be had. If then, this motion is not carried, it is probable that the ordinance will be sent back without recommendation.

N.

THE ELECTRIC LIGHT.

The electric light plant of Fremont, O., is to be enlarged.

An electric light company is to be organized at Madison, Neb.

The electric light plant in Montgomery, Ala., is being greatly enlarged.

An electric light company is to be formed in Dayton, Tenn. Dr. G. O. Bicknell is organizing it.

The letting of the electric lighting contract in Allegheny City, Pa., has been postponed until December 17th.

The sum of a quarter of a million francs has been voted for the establishment of luminous electric fountains in the Paris exhibition.

A special meeting was held at the city hall of Anoka, Minn., recently, to get the expression of citizens on securing an electric light plant. Out of the large number present, all but four voted in favor of it.

A citizens' committee in Boston recently presented a petition to the board of aldermen, asking the board to investigate the subject of street lighting. Boston pays 65 cents per night for its lights, and the committee thinks the amount too high.

There was considerable commotion in Evansville, Ind., recently when the statement was made that the newly-organized Citizens' Electric company had sold out all its rights to the Gas & Electric Light company of that place. It is now stated positively that there is no truth in the report.

The Westinghouse Electric company of Pittsburgh has closed a contract for 1,500 incandescent electric light lamps with the Electric Light company at Little Rock, Ark. This company was established only three months ago, when 1,300 incandescent lamps were purchased from the Westinghouse company.

W. T. Sampson, superintendent of the Naval academy at Annapolis, recommends in his annual report to the secretary of the navy that, in addition to the usual estimate an appropriation of $173,000 be made for the purchase of additional ground for an electric light plant, and for new furniture for the cadet quarters.

Here is a compliment from an English paper for Americans, expressed in a rather doubtful way: "Why is it that we hardly ever hear of electric light plants for India? There must be a vast field in that country. The contrast between the activity of the land of the Red Indians and that of the Hindoos is very poor indeed for the latter."

At a meeting of the Burlington, Ia., city council, November 20th, the Burlington Electric Light & Power company made a proposition to furnish fifty or more 2,000 candle power arc lamps at $7.25 per lamp per month for three or five years, and 200 or more incandescent lamps of 20 candle power at $1 per lamp per month for three or five years.

A Lisbon correspondent of *Industries* recently sent to that paper a Swan incandescent lamp, which he says "after running for about one hundred hours, sometimes slightly over its rated c. m. f., exhibited very peculiar dark bands, strongly marked on the glass. A general darkening of the bulb after a prolonged use is a very common occurrence in glow lamps; but in this case the marking took place after a comparatively short use, not in a uniform manner, the dark bands following very nearly the two turns of the filament, as if the latter had thrown off carbon particles only in certain directions." The editor of *Industries* asks for an explanation.

The electricians who are building the new electric light plant in the Federal building are so far along with the work that, for want of power, it was decided to turn off the electric light entirely from the postoffice and basement floors—the only floors provided with electric lights up to the extension of the plant, says a St. Louis paper. As the United States Electric Lighting company has until January 15th to finish the job, it is expected the plant will be run by that time. Three new dynamos have been set up.

The city council of Sault Ste. Marie, Ont., after a careful investigation has adopted the Heisler incandescent system in place of an arc system which had been in contemplation before the investigating committee took its departure. The plant will be a large one, including 125 street lamps of from thirty to sixty candle power and over 400 thirty candle for commercial and private house use. The power will be supplied by the Sault Water Power company, and the plant will be in operation by the end of December. This is the first Heisler plant in Canada, but several large ones will follow.

The Thomson-Houston company of Chicago has sold the following plants since November 15th: B. P. Foster, Findlay, O., 35 arc, to increase plant; Hastings, Minn., 12 arc; Eclipse Wind Engine company, Beloit, Wis., 150 incandescent; Oakland Gas Light & Heat company, Oakland, Cal., 275 arc lights; Niles Stove works, Hamilton, O., 50 arc, to increase plant; Northfield, Minn., 500 incandescent; Grand Fork, D. T., 1,000 incandescent: Hastings, D. T., 500 incandescent; Bismarck, D. T., 500 incandescent; St. Paul, Minn., 500 incandescent; Natchez, Miss., 100 arc, for city lighting.

Bids for furnishing Nashville, Tenn., with arc electric lights, for not less than three years nor more than five, commencing May 1st next, will be solicited by the board of public works. Bids will close January 20th. The Nashville Jenney Electric Light & Power company, by the terms of its franchise recently granted, is obligated to furnish to the city, if called upon, lights up to 100 at 30 cents each per night, and from 100 to 125 at 29 cents each per night. The number of lights to be used by the city will be, as intended now, 110. The present price paid the Nashville Lighting & Power company is 60 cents each per night.

A Harrisburg, Pa., dispatch says: Although philosophers have never been able to determine whether electricity is a condition or a theory, a case will be tried by the courts of Dauphin county next month in the hope of throwing light on a very ancient dispute. Under the act of 1885 manufacturing companies in Pennsylvania, with very few exceptions, are exempt from taxation. The state authorities have refused to recognize electric light companies as manufacturers, and several of these corporations have appealed from the settlement of the tax which the commonwealth has imposed upon them. The novel point to be decided is whether or not electricity is manufactured

At Montreal, Can., a syndicate, consisting of the Edison Electric Light company, Messrs. McLennan and Conway, engineers, and several Montreal capitalists, have purchased from the Mathews estate, for $20,000, the Isle au Heron, which is situated right in the center of the Lachine Rapids It is stated that the syndicate proposes utilizing the magnificent water power, which can be obtained by deepening the natural channel by which the island is intersected, and by directing a larger body of water through it by means of breakwaters and dams. The company proposes tendering for the lighting of the city of Montreal by electricity, as well as furnishing private houses, manufactories and other establishments with the light.

Electric lights were largely employed in decorations on the occasion of the reception of Rev. John S. Foley, the newly appointed bishop of Detroit. The Brush Electric Light company illuminated Grand Circus park, Washington avenue, St. Aloysius, church, free of charge. A force of men, under the personal direction of William H. Fitzgerald, superintendent of the company, was kept busy for three days stringing wires and putting up the lights. The fountains in the park and the trees were hung with electric lights. A cross 25 feet high, of electric lights, was placed between the two steeples of St. Aloysius' pro cathedral, and the tower was a pyramid of light. A huge "welcome" of electric lights adorned the front of the bishop's residence.

An employe of the New Orleans, Louisiana, Electric Light company, named Devlin, was killed by an electric light shock, November 15th. He received a shock previously and had left the company on that account. Two weeks before his death he re-entered the company's employ A New Orleans paper thus tells the story: The morning was very foggy and the ground was covered with a heavy dew; but Devlin felt no shock from any of the few lamps he trimmed until he reached that at the corner of Terpsichore and Front streets. The lights are extinguished at 6 o'clock in the morning and the current cut off so that the men can trim them. The trimmers are aware of this, and few if any use small benches as non-conductors in performing their work. The unfortunate young man on reaching the above corner lowered the lamp and was at work on the carbon when he suddenly felt a slight shock. He continued his work, however, when suddenly his face came in contact with the globe and he fell to the ground a corpse. His small mustache was burned off and his face was blacked and blistered in several places. Several parties who saw him fall ran to his assistance and did everything possible in the hope of reviving him, but he was dead. The coroner held an an inquest on the body, giving a certificate of death in accordance with the facts. The lights were out at the time of the accident and the current is supposed to have came from some of the incandescent lights. The body was conveyed to the residence of the deceased on Josephine street, where it was prepared for burial. About the same hour yesterday morning another of the Louisiana Electric company's trimmers, named John Walter, was knocked senseless, corner of Canal and Treme streets. Walter was in the act of changing the carbons in the lamp when he received a terrific shock, which knocked him senseless and in falling he received a slight cut in the hand. He recovered shortly after and resumed his labor.

It is proposed to fit up the building formerly occupied by the Texas Star Flour Mill company at Galveston as a central electric light station A Galveston paper says: Mr. Reymershoffer thinks it would be a good idea to utilize the building for the establishment here of a new electric light plant. Mr. Reymershoffer as alderman of the city is chairman of the special committee to provide for a new contract for lighting the city next year. It was at first suggested that the city build and operate its own electric light plant, but to this idea there has been aroused considerable opposition, and the starting of an independent light company seems the more acceptable plan to the general public, as this would give cheaper lights to private consumers through the medium of a healthy competition, and while the city in operating its own plant might secure street lighting much cheaper than at present, yet this plan would be of no benefit to the private consumer. The water commissioners are now in correspondence with Engineer Cook regarding the feasibility of using the power at the waterworks station for electric lighting.

THE ELECTRIC MOTOR.

Electricity is to be used on the proposed street railroad at Marquette.

It is reported that an electric railroad will soon be built between Augusta and Hallowell, Me.

The Iowa Belding Motor & Power company, of Davenport, Ia., has been formed by E B. Hayard and others, with a capital stock of $100,000.

The Silvey Electric company of Lima, O., has installed a four horse motor in S. M. Finch & Co.'s tank shop of that city, which will be used in running a buzz saw.

A Sioux Falls, Dak., prophet says: In two years from now you will see the population of Sioux Falls doubled. At that time the street car company will run its cars by electricity. There is nothing now which can keep Sioux Falls from being one of the prime cities of the west.

The Lafayette, Ind., electric street railway is now in operation with nine motor cars, and is carrying a large number of passengers. The road has been visited by a large number of prominent street railway managers from all sections of this part of the country, who have expressed themselves as very well pleased with its operation.

A dispatch from Ansonia, Conn., dated November 30th, says: The fly wheel of the engine of the electric car plant burst late last night into three pieces. One went through the roof, another just cleared the dynamos and went through the end of the building, and the third plowed along the floor and brought up against the iron bed plate of the dynamos The engineer was grazed by the flying fragments. The damage is $1,000.

The *State Journal* of Topeka says: Wichita's new electric railway was put in operation on Tuesday. The cars carried from thirty to forty people. Sidings were made with celerity, curves vigorously rounded, and an unvarying gait kept up that would have been discouraging to mules. The cars are lighted with incandescent burners which are supplied from the current that drives the cars. The first experiment was in every way successful. This will be good news to the Topeka company which is preparing to adopt the same system.

The electric street railway installed by the Sprague company at Davenport, Ia., has now been in operation for about three or four weeks, and the president and directors of the road express themselves as well pleased with the electrical equipment. It is a significant fact of the confidence which the directors and managers of this road feel in their electrical apparatus, that upon the date of opening the road all the horses owned by the company were advertised for sale. The first portion of electrical equipment included eight motor cars with dynamos and the overhead system.

An interesting item has recently appeared in connection with the East Harrisburg Street Passenger railway, operated on the Sprague system in Harrisburg, Pa. The average consumption of coal upon this line during the month of September was only three-quarters of a ton a day for five cars. The total receipts during the month of September were $3,600. Total expenses during the same time, including charges of every description, were only $1,200, leaving a net earning of $2,400, or at the rate of 30 per cent. per annum on the capital stock. The management feel so well satisfied with their electrical equipment that they have ordered an additional number of cars.

"Electricity as a power to drive small boats? Why, of course, we will soon have it, and it will be a great deal more convenient and pleasant than those hot steam launches and nasty little petroleum boats." The speaker, says the New York *Mail and Express*, was a prominent electrician, and he talked of the advantages of electricity over steam, and was very sure that some yachtsmen who could not afford large steam yachts would find electricity much the better power to use to propel their boats. He added: "The machinery takes up less room, and then the heat of the furnace is not felt because there is no furnace, and the smoke and grease are also done away with. They are building them in England. I have received particulars of one that has just been launched. It is 62½ feet in length, 10 feet beam, and is designed to carry eighty passengers at six miles an hour. The electric machinery and storage

cells are placed below the deck, fore and aft, leaving a clear run the whole length of the boat for passengers. In the middle is a handsomely-fitted cabin, with lavatories, dining room, etc. The electrical energy is converted into motive power, each driving in turn three-bladed propellers. Boats will soon be made to store electricity, and run just as the street cars do."

Within a fortnight a number of electric street railways of the Sprague system have been put in operation. Among them is the Brookline branch of the West End Electric railway of Boston. The line extends out Beacon street to Oak Square in Brookline, having the city terminus at Park square. The line is equipped with iron poles throughout its entire length. The cars run very successfully, and in the trial trips which have been made, run with perfect satisfaction The power station at Allston, with the adjoining car house, is of brick, and perfectly fireproof. In its construction it was the aim of the West End company to get the best in every detail. The smoke stack is 100 feet high.

Henry Villard and T. F. Oakes, president of the Northern Pacific Railway company, have purchased from Nelson Bennett of Tacoma, W. T., a three-fourths interest in his street railway system. Bennett has expended $25,000 on his system, but has a franchise over all the principal streets of the city, most of which he already occupies. Villard and Oakes pay $100,000 for the interest. The company, as reorganized, will begin immediately to improve the system by putting on new cars and greatly reducing running time, and electric motors will be put on all feasible lines, while cables will be employed on Ninth and Seventh streets. The purchase includes the water power plant on Chambers' creek, a few miles from the city, by which all necessary electricity will be generated

At a recent meeting of the Decatur, Ill., city council, Mr. Martin the representative of the Sprague company, was given an opportunity to reply to critics who had asserted that there was no intention to build an electric railway. As an evidence of his good faith, Mr. Martin suggested that the Citizens' Street Railway company deposit in a local bank $5,000, and he would do likewise. In case his company secured a franchise and did not build the proposed road, the $5,000 deposited to be used in embellishing the city park; and in case they did, the money deposited by the Citizens' company to be used for a like purpose. Mr. Martin asked that either this be done, or else let the people quit throwing mud at a stranger within the gates of the city. In due time his company expects to come before the council for a franchise.

A Toledo paper says: The new project now being agitated of building an electric street railway embracing several different lines, is meeting with very favorable consideration by most of the people along the different routes. The parties pushing the project are largely eastern gentlemen, for whom David Robison, jr., is acting as trustee in obtaining the right of way and franchise. The undertaking is a large one and means, if carried through, that Toledo will have a system of railways in her streets proportioned to her growing importance as a city. The consent for the right of way calls for an all steel railway—doing away with the old wooden stringers. This modern mode of building a street railway is as much an improvement over the old road built of wood and strap rails as the modern steam railroad is an improvement over the old strap iron railroad of fifty years ago.

The following dispatch was sent from Virginia, Nev.: Ever since the collapse of the Big Bonanza on the Comstock the problem has been to discover some process by which low grade ores may be handled profitably. The solution of this problem is claimed to be found in electricity. A successful test was made yesterday of a sixty-stamp quartz mill, which was run by electric power generated in the Sutro Tunnel where it meets the Chollar shaft, 1,700 feet below the surface. The great flow of water from the Chollar shaft is conducted in pipes, and falls on six large Pelton water wheels with a pressure of 680 pounds to the square inch. These water wheels run six dynamos in the tunnel, and the power thus generated is transmitted to the surface by copper wire and delivered on Brush motors that make 850 revolutions per minute. Of this enormous power generated in the tunnel 60 per cent. reaches the surface and runs the stamp mills. The electric plant is the largest in the world. It is claimed that this establishes the theory of electrical engineers that the great water power of the Truckee River, sixteen miles from the Comstock mines, may be utilized in this way. If the loss of power be only 40 per cent. then at least 1,000 stamp mills could be run and many low grade ores worked profitably.

THE TELEPHONE.

The Nebraska Telephone company has completed its line from Norfolk to Madison, Neb., and is at present engaged in putting up its circuits in the town.

The telephone company of Omaha, is preparing to run all their wires into the central office, on the cable plan. The wires will be noited into a cable about a hundred yards from the central office, and continued to that office in like manner.

In the case of the borough of Phillipsburgh, Centre county, Pa., which attempted, by ordinance, to levy a tax of $1. per pole, per annum, against the Central Pennsylvania Telephone & Supply company, which was resisted by the latter, a decision was rendered November 9th in favor of the telephone company.

At the instance of the Bell Telephone company, Judge Blodgett, in the United States District court, December 1st, refused to give the Inter-State Telephone company of Chicago further time to prepare its defence to charges of infringing on the rights and patents of the Bell company, and issued a perpetual injunction restraining it from further action.

The telephone system at Racine, Wis., was greatly damaged recently by a telephone wire breaking and falling upon an electric light wire, which sent the current into the central station, thus destroying nearly all of the connecting wires, and for a time causing a suspension of business.

The life-saving stations along the coast from Lewes, Del., to Chincoteague, Va., have now telephone communication. The work, which has been in progress since September, was completed November 14th The work was done by William Bolton, telephone expert of the life-saving service, under the direction of Lieut. Kimball.

THE TELEGRAPH.

A telegram from St. Louis dated December 2d, says: The Western Union Telegraph company absorbed the Atchison, Topeka & Santa Fe telegraph system at 12 o'clock to day. An order was sent out at the same time reducing rates about 25 per cent. to all points on the Atchison system. There were about 2,000 miles of telegraph line involved in the purchase, and about 1,500 miles of it are in Texas and in the Indian Territory. The system was originally operated by the Baltimore & Ohio, and afterward reverted to its owner. It did a heavy commercial business in Texas.

New inventions in telegraphy are becoming frequent. The last is noticed in the following dispatch from Panama: Senor Piedrahita, an electrician of Bogota, has patented a telegraphic instrument which, he claims, will revolutionize telegraphy, as it works without batteries. The government appointed a committee of experts to examine into the merits of the machine. In their first report they say: "The 12th of October we proceeded outside the city and placed the new apparatus in connection with the telegraph to the city, and without a battery we held communication with the main office. * * * October 16th we practiced another test, and sent messages over a wire 600 meters long, which was hung on posts without insulators, and some portions of which were allowed to trail along the ground. Once our machine was in order we sent messages over this wire in Spanish, French and English, and they were received without difficulty. The strength of the current received from us was tested, and it showed a density of 400 ohms, equal to a distance of 7½ leagues, and over this range we could have communicated had our wire stretched that distance."

C. D. Lathrop & Co., coffee merchants in Chicago, recently sued the Postal Telegraph company for $10,000 damages, claiming that they lost a clear $8 000 by the defective transmission of two messages The firm says that June 13, 1887, they telegraphed Crossman & Co. to buy them 1,000 bags of August coffee. That message went through all right. Then they wired: "Please buy, in addition to 1,000 August, 1,000 cheapest month." It is alleged that the operator sent it: "Please buy, in addition to 2,000 August, 1 000 cheapest month." Crossman & Co. supposed that Lathrop & Co. had increased their order 1,000 bags and bought 2,000, so that Lathrop & Co. were out just $4,000. June 17th the Chicago firm sent this dispatch: "Put stop order on 5,000 December at 17 cents. This order good until countermanded" The operator said: "Put stop order on 5,000 December at 70 cents." Crossman & Co. wired back: "Don't quite understand. Is stop order at 17 or 16.70?" Lathrop & Co. corrected the blunder, but in the delay the New York agents did not sell at 17, and when they got the proper direction they had to sell at the market price, 16.55 cents. That cost Lathrop & Co another $4,000. The firm recovered $6,698 30.

Miscellaneous Notes.

At a meeting of the Albany, N. Y., common council November 12th, a committee was appointed to investigate the subject of burying the wires in the city.

The Pacific Electric Storage company of San Francisco, will soon begin the erection of a suitable building at Sausalito for the storage of electricity for lighting and power purposes. The structure will be 300 feet in length.

It was recently decided to create in Toledo, O., the office of city electrician. The official is to have control of all wires and to supervise the erection of all poles, inspect the electric currents of the lights, railways, etc., and to give his entire time to the work at a salary of $1,000 per year.

The Corning, Ia., Electric Light company has purchased through the Chicago office of the Waterhouse Electric & Manufacturing company a series incandescent plant of some two hundred 25 candle power lamps, in the circuits of which they will also operate a few arc lights. The incandescent lamps will be used for street lighting as well as commercial lights.

The Milwaukee, Wis., Storage Battery company has been incorporated by H. H. Stafford, H. T. West, and A. G. Weissert, with a capital stock of $100,000. The object of the corporation is to purchase the license for Wisconsin and the Michigan peninsula of the Woodward Electrical company's patents, and to sell or rent storage batteries for motive power and electric lights.

A Washington correspondent writes: Just at this time many of the streets are being torn up by gangs of workmen who are making repairs, or putting down the conduits for the various kinds of electric wires. At the last session of congress, the district commissioners were prohibited from permitting the erection of any additional telegraph, telephone, electric lighting or other wires over any of the streets or avenues after September 15, 1888; and the commissioners were also directed to report at the next session of congress the best method of removing all electric wires from the air or surface of the streets, and interring the same. As it is, there are laid already of telegraph, telephone, fire and police wires in the district, 17 miles of underground conduits, and 2,000 miles of wires underground. There remain about 4,000 miles of overhead wires which in course of time will likewise be buried. The telephone companies alone have about 1,356 miles of underground wires.

The Pittsburgh, Pa., Phonograph & Graphophone company, consisting of well-known business men, has applied for a charter, and as soon as that is received the preliminary arrangements for supplying these instruments will proceed. The company will have a capital stock of $750,000, and will supply both the phonographs and the graphophones to patrons in Pennsylvania west of the Susquehanna River and in all parts of West Virginia.

Electricity is gradually being introduced in ceramic operations to purify quartz and kaolin from oxide of iron. The powder to be operated on is placed in a hopper, whence it falls into a receiver rotating rapidly on a vertical axis. This receiver is surrounded by powerful magnets of triangular section. The purified powder then falls into a second receiver, and after undergoing a similar purification in this, it is, as a rule, ready for use. The cost of this process is small, and it is stated that owing to its employment substances can now be used which were formerly rejected on account of the amount of iron contained in them

Those who believed that the National Subway company obtained its franchise from the council only as a money-making scheme are apt to be disappointed, as preparations are being made to begin work on the manholes at once, says a St. Paul paper. J. P. Dorsett, the manager of the concern, applied to City Engineer Rundlett yesterday for a permit to begin work on the streets. Mr. Dorsett announces that he has already engaged a force of men to begin work at once. He will look over the ground with Mr. Rundlett and decide upon the most feasible place to begin operations. The company has been at work in Minneapolis for some time, and quite a large amount of work has already been accomplished in that city.

A Baltimore dispatch says: The merchants of Baltimore are waging war on the telegraph and telephone companies about the unsightly poles strung with hundreds of wires which line the principal streets. Recently the electric light companies also began the erection of poles. When the workmen were ordered off the premises in the daytime, the poles were quietly placed after dark. William Reed, a prominent business man and a member of the firm of Morton, Reed & Co., was arrested, charged with maliciously destroying property of a telegraph company. He had chopped down a pole placed in front of his store. A delegation of merchants then applied to the mayor, and he instructed the city solicitor to apply to the court for an injunction to restrain the company from erecting poles without permission. The citizens generally are determined that the poles and the overhead wires must go. After the arrest of Mr. Reed the company had the pole replaced in front of his store, and he has again ordered it to be chopped down. His case will test the law on the subject.

The following is taken from the London *Electrical Engineer*: "The typical American is, perhaps, one of the keenest business men existing upon the face of this globe, but even he is beginning to see that there may be an excess of competition, and we find that suggestions are being made as to caution in this direction. We have heard friends from the other side describing with that inimitable brogue of theirs that manufacturers do not want the machines they sold to last forever, nor do contractors agree to put in work that should stand through ages. We prefer, said one *vis-a-vis*, to have a change about every twenty years, if not sooner, so that there may be more trade going. However correct this may be from a business point of view, we are glad to see such remarks as the following, as they indicate the tendency of thoughtful men in America: 'In harnessing electricity and subverting it to the uses of men, it is more necessary to have perfection—absolute perfection—in the various accessories than in any other of the great forces; for of all of them electricity is the subtlest and the hardest to control. Hence, we wish to say to manufacturers, construction and supply companies, do not ruin the business by unbusiness-like competition in your anxiety to secure trade; and to the contractor and builder, do not be dazzled by low prices in either electrical machinery or construction, but be sure you have the best and be willing to pay a fair price for it.'"

The driving clock of the large Lick telescope, says James E. Keeler in the *Scientific American*, was provided by the makers with an electric control, for keeping its rate in exact coincidence with that of a standard astronomical clock The vertical shaft of the governor rotates in one second, and has near the bottom a small projecting pin. A stud on the end of the armature lever of an electro-magnet is struck by the pin as the governor shaft rotates, when a current is passing through the magnet; but when the current is broken once a second by a standard clock, the stud is withdrawn at the proper instant to allow the pin to pass. There is also an ingenious and beautifully constructed attachment for breaking the circuit in case the standard clock should, either by accident or design, omit one or more seconds in a minute. The driving clock is adjusted to run a little fast, and is continually checked by the control, the governor being allowed to rotate by turning in a friction collar. It was found, however, that the impact of the pin on the governor shaft against the stud of the armature caused a shock which was transmitted to the telescope and produced a disturbance of the image fatal to photographic work. The control was therefore removed, and another, which I devised for the purpose of giving a perfectly smooth motion, was substituted for it. The new control answers its purpose so well and is of such extreme simplicity, that I shall give a description of it here, as it can be applied to any clockwork having a shaft which rotates in an integral part of a second. A soft iron sector subtending an angle of 36°, and having a radius of six inches, is

clamped to the vertical axis of the governor, and rotates in a horizontal plane. The sector passes very close to the poles of an electro-magnet (part of the old control) which is mounted on a slightly elastic standard of steel. At every second a strong current is sent through the coils of this magnet by means of a standard clock, the circuit being closed, as in the case of the old control, by the relay points of the chronograph attached to the driving clock. The driving clock is set so as to run a little too fast, and when the governor is started the sector gradually gains upon the click of the chronograph until it reaches the magnet of the control, when the friction produced by the attraction of the latter prevents any further acceleration, and the governor will rotate in exactly one second by the standard clock as long as the control is in operation. The elasticity of the support on which the electro-magnet is mounted plays an important part in the proper working of the control. When the sector passes at the exact instant of the passage of the current, the magnet springs in toward the sector and comes into actual contact with it, very greatly increasing the friction, while the passage of the sector at any other instant meets with no resistance, the magnet being slightly withdrawn by its support. The current used with the control is obtained from the battery of twenty gravity cells, employed during the daytime in transmitting time signals to San Jose. As the signals are not sent at night, the battery is then connected with the control by turning a switch. With this control no shock is communicated to the telescope, and the image of a star is steady.

Personal Paragraphs.

Enos M. Barton, president of the Western Electric company of Chicago, left for New York last Friday. He was accompanied by Charles E. Scribner of the same company. They will sail from New York next week. Mr. Barton will pass a few weeks with his family, who are now in Berlin. Mr. Scribner's destination is Antwerp. He will make his headquarters for a few weeks in the factory of the Western Electric company in that city.

The executive abilities of B. E. Sunny, whose identification with the electrical interests of Chicago are extensively known, have again secured distinguished recognition in the tender of an important position in the western office of the Thomson-Houston Electric company, Chicago. Mr. Sunny was for a long time superintendent of the Chicago Telephone company, and his ability in organization, as evinced by the steady advance of that service from inefficiency to thorough efficiency, secured for him the offer of the presidency of the Chicago Arc Light & Power company. The offer was accepted, and though the vast undertaking of the company of consolidating nine different stations, and installing in the main part of the city one great central station, was well under way, still affairs were in a rather chaotic state when he assumed office. With his accustomed energy Mr. Sunny set to work, and in less than a year has most thoroughly organized that service. He will retain the presidency of the Chicago Arc Light & Power company, as the directors were unwilling to dispense with his services. Mr. Sunny is a man of broad ideas and excellent judgment, and is gifted with the talent of execution. With General Manager Barton of the Thomson-Houston company he will have more opportunity for the application of his qualifications, and is bound to achieve a notable success. He will accept our congratulations on his preferment. C. H. Wilmerding will act as superintendent of the Chicago Arc Light & Power company. Though not widely known in Chicago he has had an extensive experience in electrical pursuits with the Westinghouse company, and with the Electrical Accumulator company. He is a civil engineer as well, and will bring to his new field of work a fine scientific and practical training.

Business Mention.

The Hill Clutch works of Cleveland, O., are furnishing Messrs. Swift & Co of the Union Stock Yards, Chicago, a number of friction clutches for their electric light plant and other purposes.

Lowder & Beller of Sioux City, Ia., have recently added to their sheet metal and furnace trade an electrical house goods department. They have with them a practical electrician, and will carry all the attractive novelties in this line.

F. M. Sparrow of 141 Milk street, Boston, Mass., has a very neat system of electric heat regulation. In operation the system is automatic, depending for action upon a thermostat which may be placed in any room. The system is economical, convenient and reliable.

Since the Crosby Steam Guage & Valve company built its new factory at Charlestown, by which facilities for manufacturing its specialties were greatly increased, its business has increased in like proportion; and to meet this growth, and in anticipation of its continuance, it has enlarged its salesroom and office at 93 Oliver street, Boston, by adding a large portion of the adjoining store. The establishment has undergone a thorough reconstruction and renovation, and is a model of neatness and comfort, and perfect adaptation to the needs of the business. It will carry a full stock of its own products, from which all orders can be filled promptly, and also complete lines of engine and boiler supplies.

Frank Thone, electrician of the Hawkeye Electric Manufacturing company, is now working upon a new lighting system. The company has recently been reorganized, its capital stock largely increased, its works removed to Davenport, Ia., where the extensive buildings formerly occupied by the Donohoe Foundry company have been purchased, and the facilities for turning out a largely increased line of machinery of every description used in the electric light and power business, greatly augmented. William Bowen, the general manager of the old company, and Frank Thone, electrician, go with the new company. The officers and members of the new company are among the most solid business men of Davenport, and are as follows: President, M. L. Marks; secretary, Walter Chambers; directors, M. L. Marks, Walter Chambers, L. P. Best, Jens Lorenson, James Thompson, James P. Donohue and E. P. Lynch. The capital stock of the new company has been increased to $250,000, of which $75,000 is already paid in, the balance to be on call of the directors. Recent sales include 200 arc lights, six 25 light dynamos to the Consolidated Electric Light company of Kansas City, Kan.; a 400 light incandescent plant, Baltimore Block, Kansas City, Mo.; a large motor and generator, Missouri Pacific railway, McPherson, I. T.; 600 light increase incandescent plant at Storm Lake, Iowa, and several motors in Chicago.

Electrical Patents.

Issued November 27, 1888.

393,348. Apparatus for Removing Metallic Particles from Paper Pulp. Charles H. Atkins, Boston, Mass.

393,353. Porous Cup for Galvanic Batteries. Horatio J. Brewer, New York, N. Y.

393,365. Switch or Circuit Changer. William W. Griscom, Haverford College, Pa

393,373. Electric Motor. Fred J. Keller and James W. Carnes, Massillon, Ohio.

393,389. Controller for Electric Circuits. Walter J. Paine, Boston, Mass.

393,391. Filament for Incandescent Lamps. Gilbert S. Ram, Montclair, N. J.

The second claim follows: "The process of manufacturing filaments, consisting in first submitting natural fibers to the action of hydrochloric acid, then washing, next submitting said fibers to a bath of strong sulphuric acid, and then washing and incorporating metallic salts, and finally baking."

393,395 Galvanic Battery. Hilborne L. Roosevelt, New York, N. Y.

The claim is: "A cover for a battery cell composed of vitreous material provided with one or more openings for the passage of the electrodes, and one or more electrodes extending through said openings and supported thereby, and provided with connectors outside the cover, whereby the deleterious effects of the fumes from the battery fluid upon the connectors are avoided."

393,396. Natural Gas Protective Extinguisher. Charles E Scribner, Chicago, Ill.

This invention consists in electro-magnetic apparatus so combined with the gas pipes and the flame that on extinguishing the flame the apparatus will be operated automatically to cut off the gas supply.

393,402 Device for Exhibiting Magnetic and Non-Magnetic Watch Movements. Alfred C Smith, New York, N. Y.

393,405. Arc Light. Donlee B Turner, Chicago, Ill

The invention relates to arc lights, and has for its object the construction of a convenient and cheap lamp in which both carbons are fed

The last claim is appended: 'In an arc light, the combination of the carbons with the shunt magnet, and circuit-closing magnet in the arc circuit, and a movable core piece which is non magnetic toward the circuit-closing magnet, and is supported in both of said magnets, and is adapted to operate the magnets, and means connecting the movable core with the carbons"

393,422 Oiler for Commutators. Thomas E. Craig, Akron, O.

393,431. Train Signal. Albert C. Griggs, Wilmington, Del

393,447. Electric Arc Lamp. Gustav Pfannkuche, Exeter, N. H.

393,448. Regulation of Alternate Current Generators. Gustav Pfannkuche, Cleveland, O.

The invention has reference to improvements in alternating current dynamos, the object being to render such dynamos self exciting and self regulating. The dynamo is specially designed for use with systems of distribution in which the translating devices are, in multiple branches, derived from a main or trunk line, and in which it is designed to maintain a constant difference of potential at the terminals of the derived branches or working circuits, which are frequently at great distances from the generator.

393,469. Dynamo Electric Machine. William W. Griscom, Haverford College, Pa.

The improvements specially concern the construction of the armature. The first claim reads as follows: "The combination, in a dynamo electric machine, of an armature composed of two parallel cast iron rings, strips of tinned iron uniting said rings at equidistant circumferential points, and one or more layers of soft iron wire enveloping said strips in non-magnetic contact therewith."

393,470. Distribution of Electricity by Secondary Batteries. William W. Griscom, Haverford College, Pa.

The fourth claim is given: "The combination of a charging circuit, a secondary battery to be charged therefrom, and a switch or circuit changer for varying the position of said battery with respect to said circuit, consisting of two pairs of fixed contacts, a pair of movable contacts common to both fixed contacts, a second pair of movable contacts connected together through an artificial resistance, a single movable contact for electrically uniting one of said pairs of fixed contacts."

393,473. Incandescing Electric Lamp. Edward H. Johnson, New York, N. Y.

393,477. Art of Laying Underground Conduits. Wilmot Lake, Washington, D. C.

393,508. Multiple Switch Board. Milo G. Kellogg, Hyde Park, Ill.

The invention refers to a metallic circuit telephone exchange system; and it consists: First, in a system of testing at one board of a multiple switch-board system to determine whether a line is in use at another board. It consists, secondly, of apparatus and a system of connecting wires to the apparatus, whereby one loop switch-plug only, is required for making the connection between two such wires, and whereby the calling annunciator of the subscriber who made the call may be utilized as the clearing-out annunciator of the circuit of two subscribers' lines connecting together, while the calling annunciator of the subscriber who was called, is switched from the circuit.

393,509. Multiple Switch Board. Milo G. Kellogg, Chicago, Ill.

The invention relates to telephone exchange systems in which part of the subscribers' lines are siogle circuit lines and part of them are metallic circuit lines; and it consists of apparatus for and a system of switching together the various lines of the exchange system in the operation of the exchange system and a system of testing at one board of the exchange to determine whether a line is in use at another board.

393,525. Automatic Gas Lighting and Extinguishing Apparatus. Nathaniel H. Shaw, Somerville, Mass.

393,529. Telephone Exchange. William B Vansize, Plainfield, N. J.

393,558. Electric Letter Box. Charles P. Harms, Hoboken, N J.

393,572. Apparatus for Propelling Cars. Leonard Paget, New York, N. Y

393,573 Storage Battery. Leonard Paget, Trenton, N. J.

393,574. Electric Light Regulator. Leonard Paget, Trenton, N. J

393,575. Secondary Battery. Leonard Paget, New York, N. Y.

The fourth claim follows: "The within-described method or process of preparing an electrode for use in a secondary or storage battery, which consists in first mixing the active material or material to become active with a flux, second, melting or fusing said mixture, and third, immersing the support or frame for holding said material in this molten mass and then removing it and allowing the whole to cool, repeating the action until the coating of the material upon the support has attained the desired thickness.'

393,576. Secondary Battery. Leonard Paget, New York, N. Y.

The first claim reads: 'An electrode for a secondary or storage battery, having the active material or material adapted to become active composed of oxydizable matter integrally attached to one or more corrugated sustaining strips."

393,577 Secondary Battery. Leonard Paget, New York, N. Y.

393,590. Regulator or Cut-Off for Generators. Daniel W. Smith, St. Louis, Mo.

393,596. Electro-Fluid Pressure Engine. George Westinghouse, jr., Pittsburgh, Pa.

393,612. Telephone System. Charles W Brown, Montreal, Quebec, Can.

The system to which the invention applies is that which has been adopted for large buildings to secure telephone communication between the numerous departments therein. Such a system is shown and described in patent No. 356,427, granted to C. E. Scribner, and which he calls a factory telephone exchange.

Claim 2 reads: "In the individual station of a local telephone system, the combination of an individual local circuit-closing key or terminal of such station, a terminal of one pole of a main battery circuit, and a circuit confined to such station connecting such calling key through spring contact and telephone-hook with one terminal of an electro-magnet for operating call bell, the other terminal of the magnet leading to the other pole of said battery circuit or to ground, all arranged and operating in the individual station."

393,622. Conduit for Electric Railways. Madison Dallas, New Orleans, La.

393,624. Coin Operated Induction Coil Charles Durieux, New Orleans, La.

393,625. Coin-Operated Induction Coil. Charles Durieux, New Orleans, La.

393,636. Dynamo Electric Machine and Electric Motor. Warren P. Freeman New York, N. Y.

The second claim is: "The combination of a four or more pole field magnets alternating in polarity with two iron multipolar armatures, one having an angular lead with respect to the other, and each armature having an independent commutator."

393,637. Electric Striking Attachment for Clocks. James H. Gerry, Brooklyn, N. Y.

393,639. Galvanic Battery. James L. Gethins, Boston, Mass.

393,657. Electric Light Burglar Alarm Indicator. Richard Packer and Isaac E. Cochran, jr., Chester, Pa.

393,704. Globe for Electric Lamps. Salomon Hiemann, New York, N. Y.

393,710. Electric Bell. Adam Lungen, New York, N. Y.

393,711. Electric Door Opener. Adam Lungen, New York, N. Y.

The invention has to do with that part of the apparatus which is located within the door frame, and its object is to construct such a device of very few parts and to make it compact and simple and certain in its operation.

393,733. Incandescent Electric Lamp Socket. William F. Wollin, Lancaster, and Elmer H. Werline, Williamsport, Pa.

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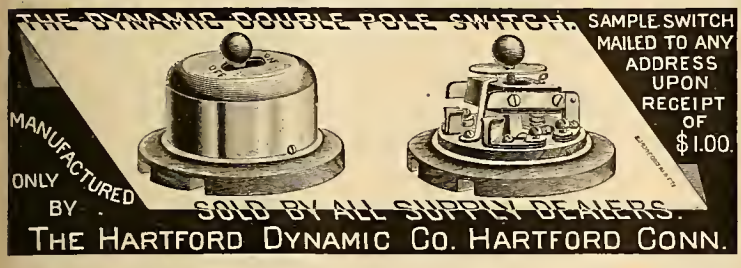

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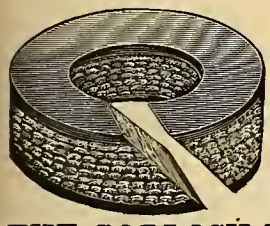

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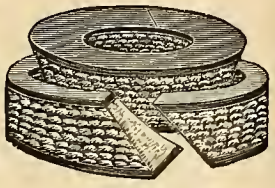

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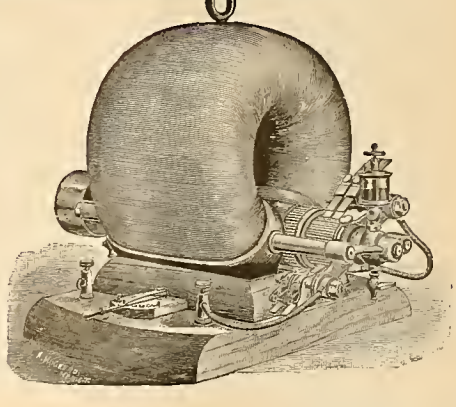

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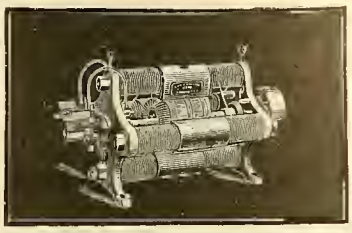

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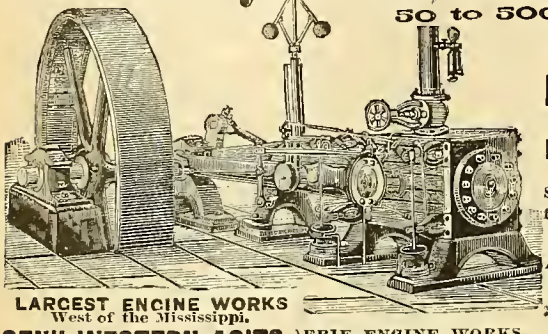

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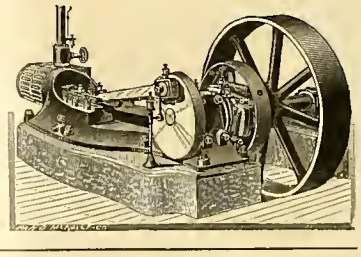

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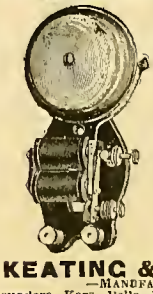

Of dealers and others is called to this bell, the advantages of which can readily be seen in its adjustment for regulating the spring which supports the Armature. By simply turning a screw the spring is made to conform to the strength of battery current, one cup of battery will work it louder and stronger than will two or three others of different make.

We can supply it in either bracket or box form; it is nicely nickeled and put up in the best of workmanlike manner. Prices furnished on application.

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Sounders, Keys, Bells, Batteries, etc., dealers in all kinds Electrical Supplies.

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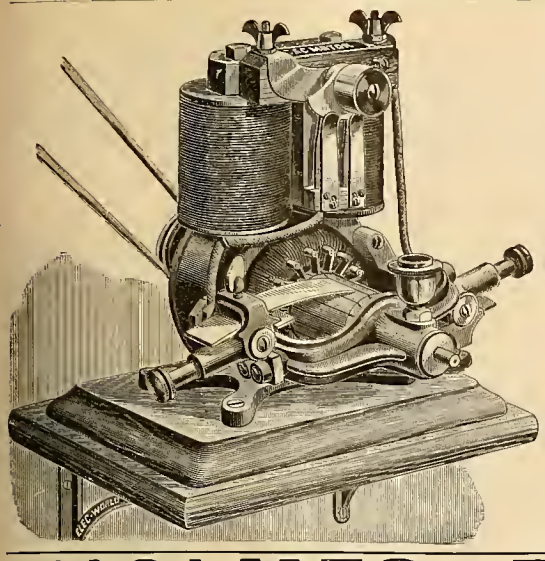

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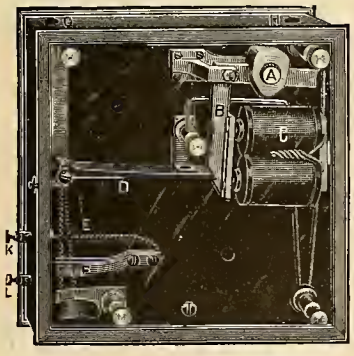

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Wright's Armature Protector Absolutely Protects

Armatures from injury resulting from the short circuiting of machines. No machine can burn out if protected by Wright's Armature Protector. One of the most valuable inventions of recent years.

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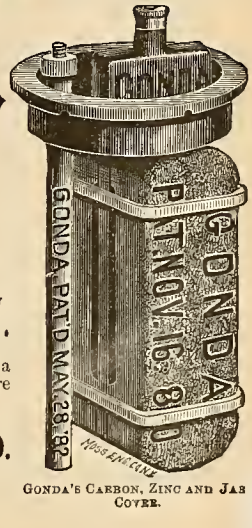

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Office of Van Depoele Electric M'fg. Co.
Chicago, Feb. 16, 1886.

Anti-Magnetic Shield & Watch Case Co.

Gentlemen : — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good timekeeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.

Sure protection from all Electrical and Magnetic disturbances.
Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

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The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and in operative on account of their susceptibility to the all-pervading magnetic influence.

AMERICAN WATCH CO.,
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THE LIST OF SALES OF THE

Westinghouse Engines: Compound, Standard and Junior,

FOR THE MONTH OF OCTOBER, 1888,

Is too long to publish *in extenso* as an Advertisement. Orders were received on eighteen working days, the five heaviest days yielding respectively, 16, 11, 10, 8, and 7 ENGINES EACH.

TOTAL, 86 ENGINES, AGGREGATING 3310 H. P.

Sales for August, September and October were over 200 ENGINES of all types, aggregating nearly *10,000 HORSE POWER*. Note in connection with the above exhibit, that our current advertising expenses for 1888 are about one-half that of any preceding year.

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The Woodbury

AUTOMATIC

Cut-Off High Speed

ENGINE.

MANUFACTURED BY

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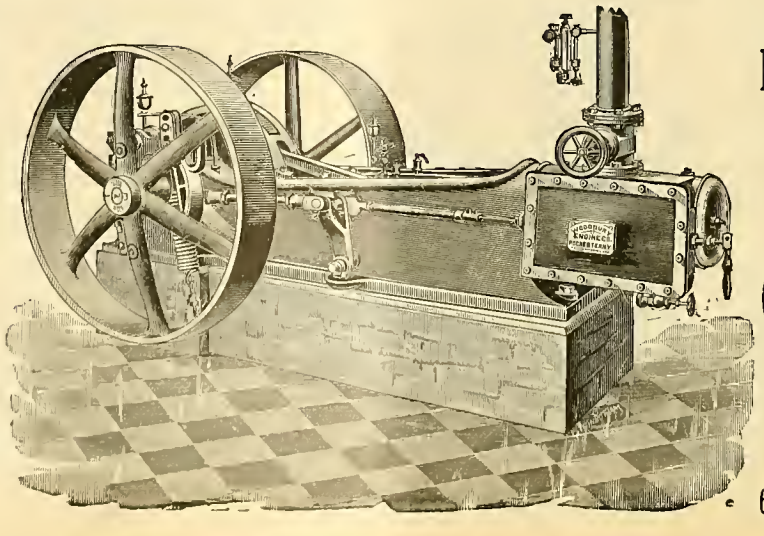

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—AND—

Double Valve Medium Speed

AUTOMATIC

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—AND—

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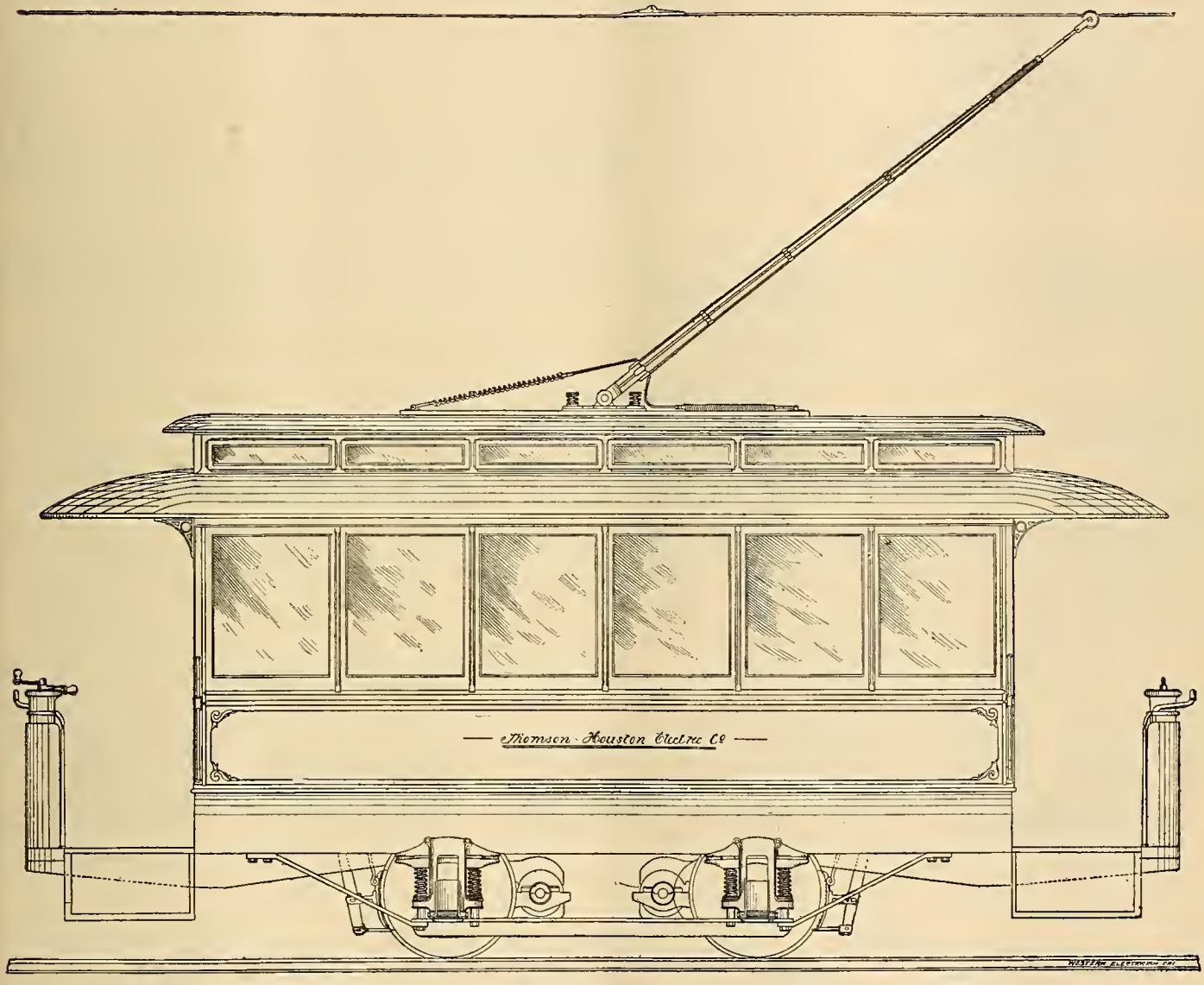
The Thomson-Houston Electric Railway System.



Nineteen Roads in Daily Operation Under the Thomson-Houston Patents.

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The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Thomson-Houston patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

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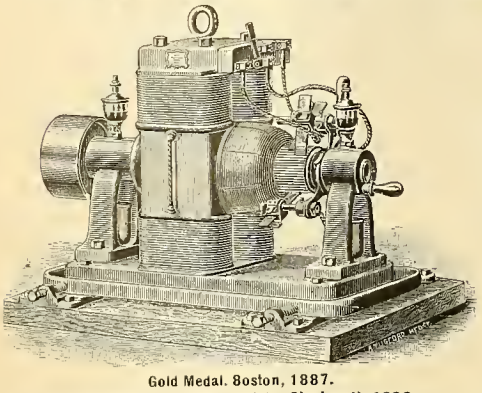

Gold Medal, Boston, 1887.
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Varies the E. M. F. from the Armature Directly with the Resistance on the Lamp Line. The Perfection in Regulation attained by this method, enables us to furnish

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Chapter VI. The Smee Battery.
Chapter VII. The Grenet Battery.
Chapter VIII. The Daniell Battery.
Chapter IX. The Grove Battery.
Chapter X. The Bunsen Battery.
Chapter XI. The Carbon Battery.
Chapter XII. Nickel-Plating Battery.
Chapter XIII. Fuller's Mercury Bichromate Battery.
Chapter XIV. The Leclanche Battery.
Chapter XV. The Diamond Carbon Battery.
Chapter XVI. The Law Battery.
Chapter XVII. Gravity Batteries.
Chapter XVIII. Dry Batteries.
Chapter XIX. Classification of Batteries.

Elementary Data.
Chapter XX. The Electric Current.
Chapter XXI. Ohm's Law.
Chapter XXII. Conductors and Insulators.
Chapter XXIII. Direction of the Current.

Connecting Batteries.
Chapter XXIV. Connecting Batteries.
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Chapter XXVI. Cells Connected in Multiple Arc.
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Chapter XXXIX. Push Buttons.
Chapter XL. Buzzer.
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Chapter XLII. Annunciators.

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Chapter XLIV. Hotel Fire Alarm and Room Call.
Chapter XLV. The Hess System.
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Chapter LXI. How to Fish Wires.
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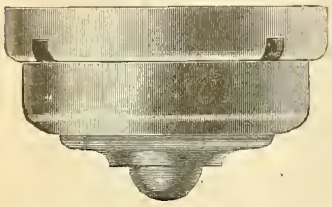

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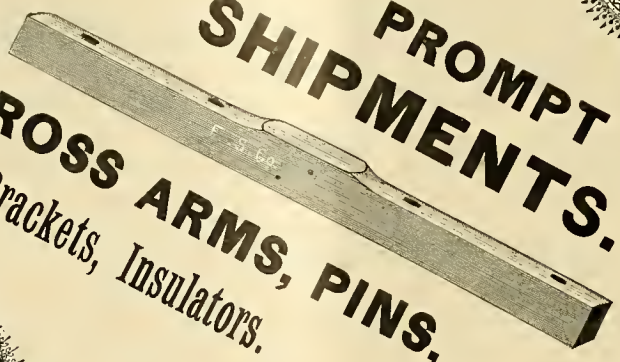

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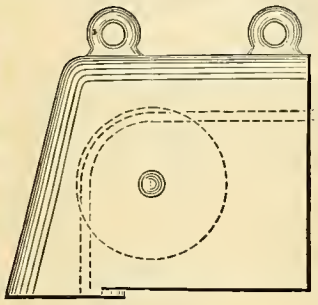

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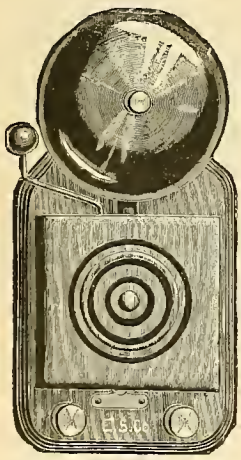

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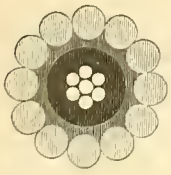

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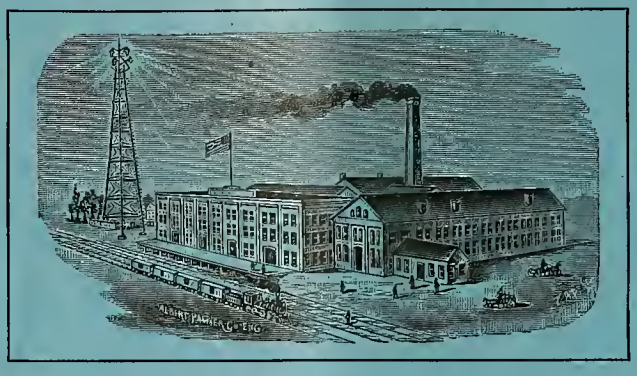

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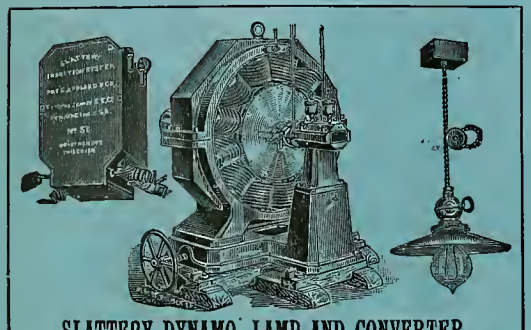

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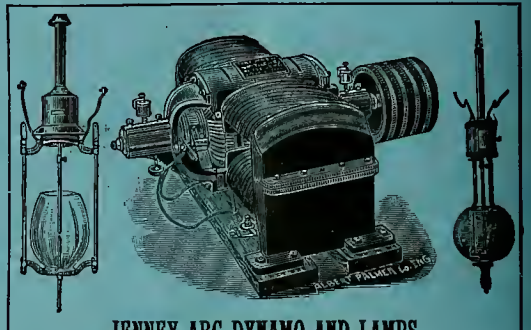

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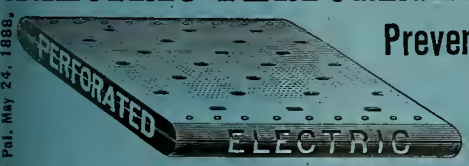

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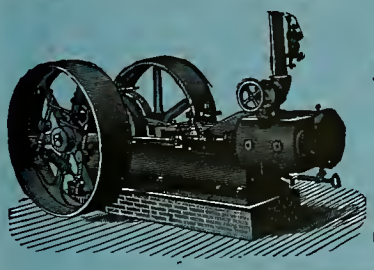

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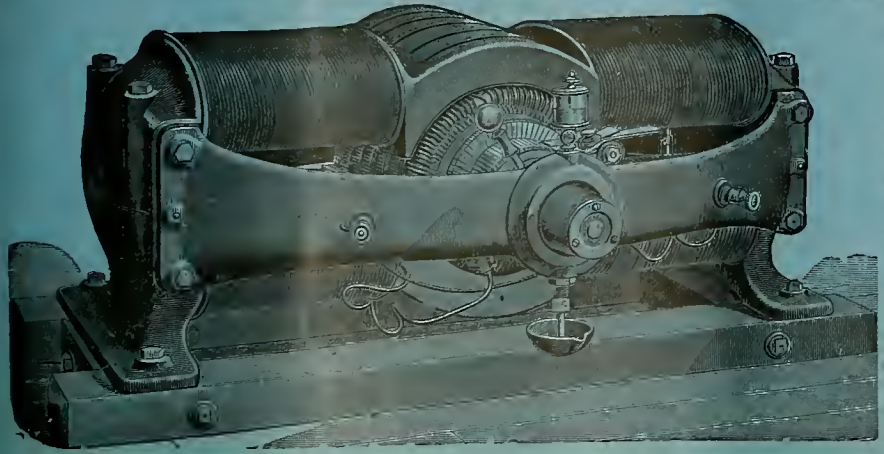

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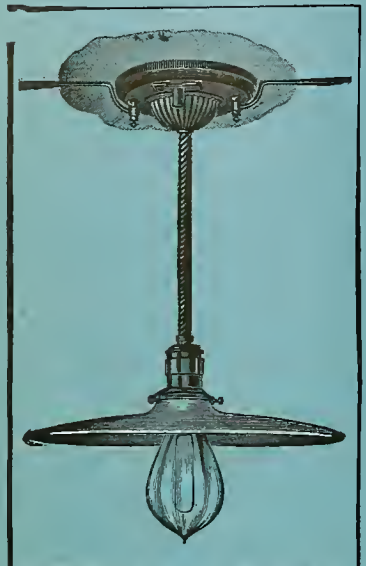

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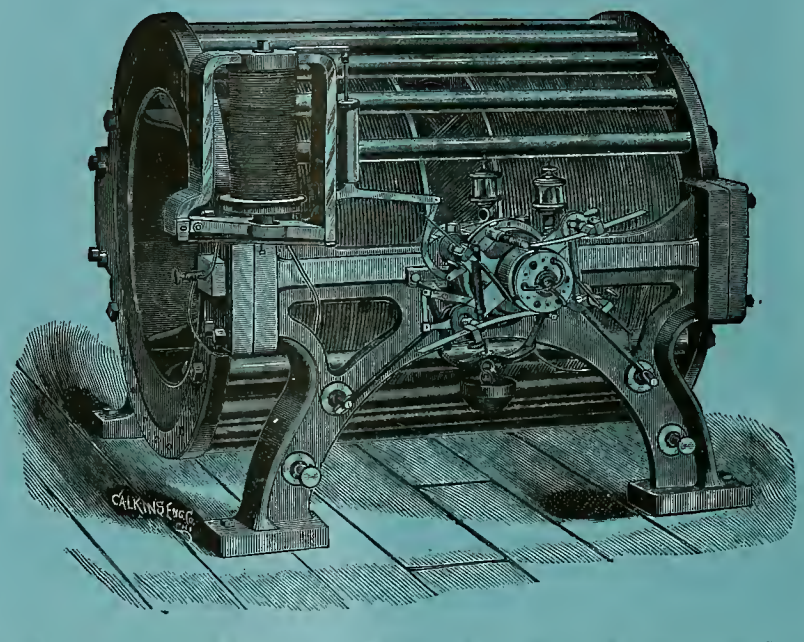

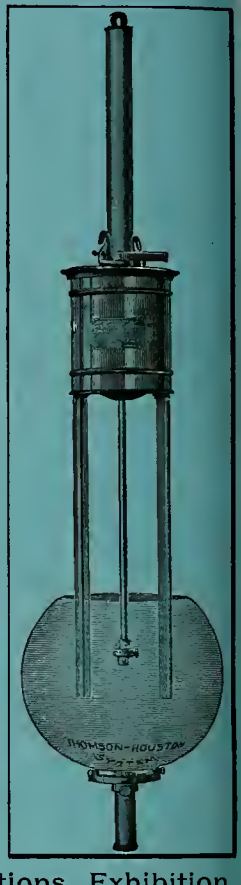

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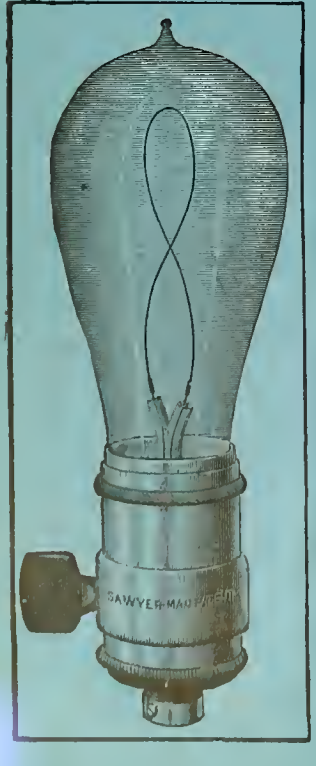

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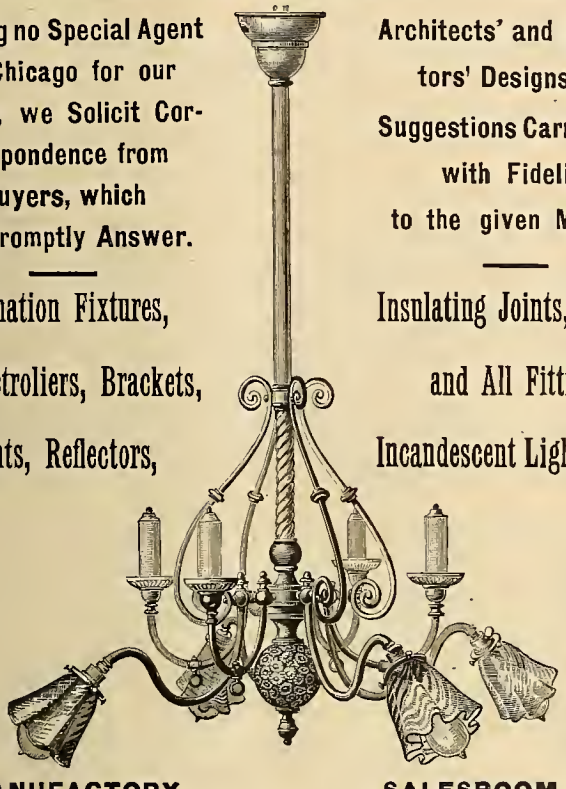

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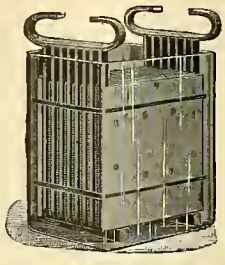

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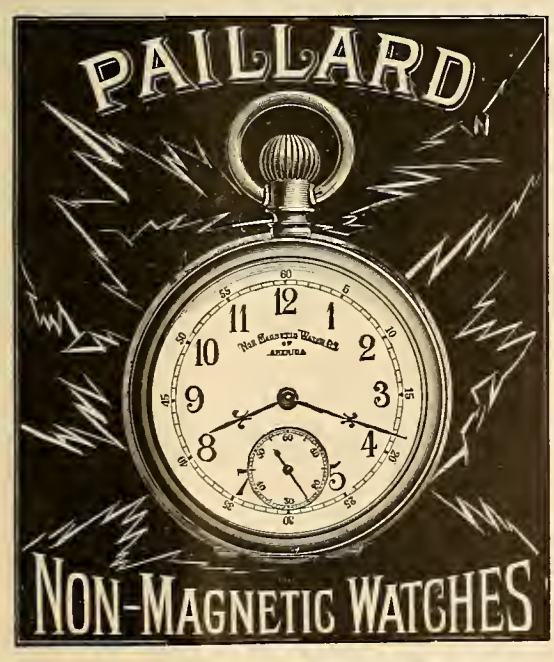

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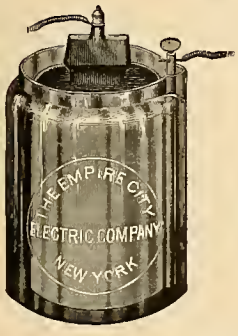

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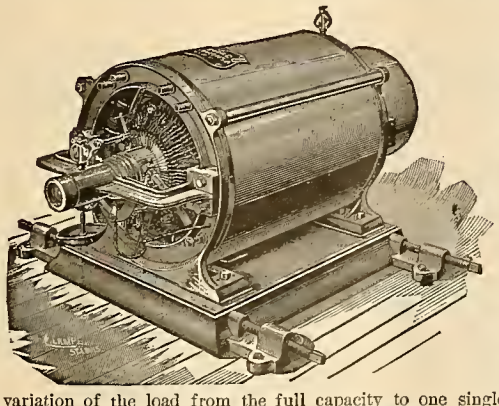

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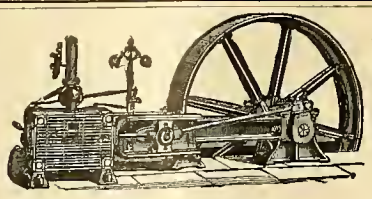

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This Company's Meter measures the whole current by a positive mechanical movement.

It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

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Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

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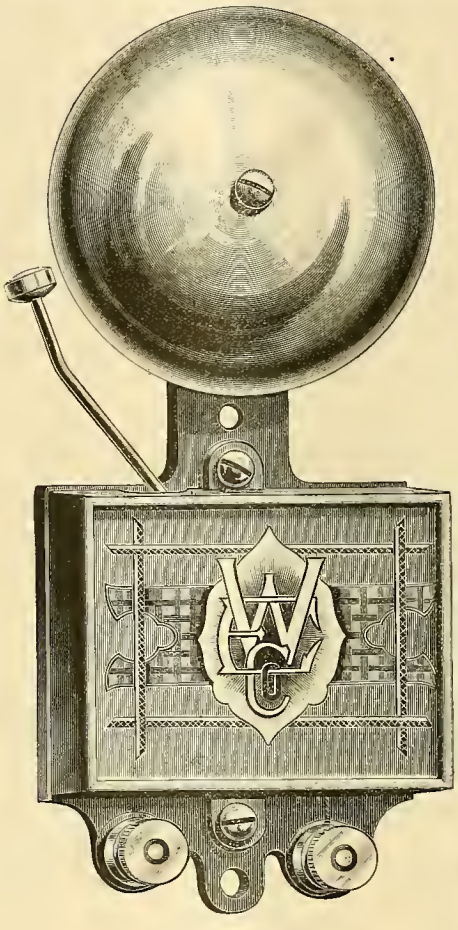

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Bronze Push No. 1004.

Price, 75 Cents.

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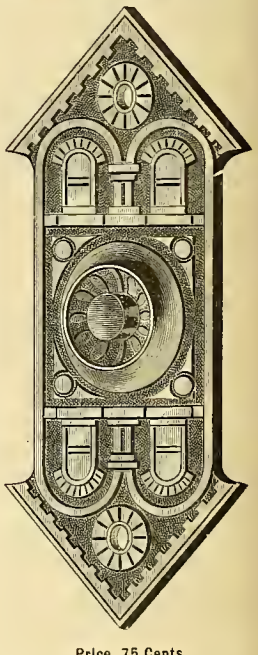

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Vol. III. CHICAGO, DECEMBER 15, 1888. No. 24

Thomas' Electric Motor.

The accompanying cut illustrates an electric motor recently designed by William M. Thomas, and made by the Knapp Electrical works of Chicago. This motor, it is claimed, is practically automatic, is small and compact, and of high efficiency. There is no sparking of the brushes, and the commutator works with perfect smoothness. Sizes ranging from ½ horse power to 8 horse power have been constructed. These motors can be used for either incandescent or arc systems, and are furnished for any circuit. These motors are specially designed for printing presses, machines, lathes, pumps, ventilating fans, etc. Mr. Thomas contemplates putting a 1-16 horse power motor on the market soon, which will be specially designed for running sewing machines.

Fort Wayne Jenney Company.

The Fort Wayne Jenney Electric Light company has decided to rebuild at once its works, which were recently destroyed by fire. In the meantime, Treasurer McDonald has arranged to place the company's shop at Plymouth, Ind., in shape for operation. The necessary machinery has been ordered from Chicago. In reference to a permanent location, the company has received offers to locate at Alliance, O., and South Chicago, but it is thought that if the city of Fort Wayne guarantees it adequate fire protection, it will rebuild in that city.

Mr. McDonald, in speaking of the matter, stated that he did not believe the waterworks had a sufficient supply of water on hand for an emergency like that of a great fire. In the Jenney fire $300,000 was lost, a large proportion of which might have been saved with an abundance of water. His idea is to form a reservoir close to the works, and keep in it a body of water for use in case of fire only.

"It would never do to let the Jenney company go away from this city," says the Fort Wayne *Gazette*, "on account of this matter, for it spends almost enough money here every year to build a new set of waterworks."

Baxter Motor Company.

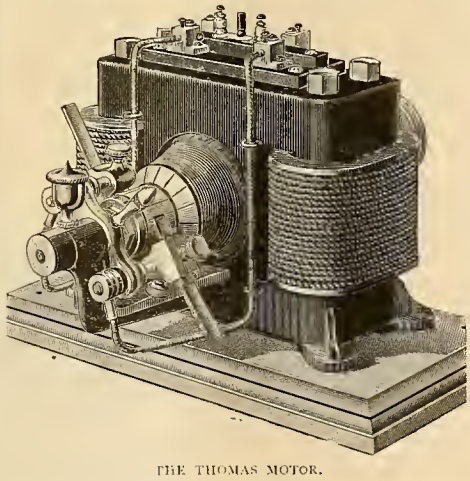
The press dispatches contained an exceedingly inaccurate report of the meeting of the directors of the Baxter Electric Manufacturing & Motor company, at Baltimore, last Monday. This corporation has for several months had in view a reorganization. In pursuance of this plan the directors decided to execute to J. Frank Morrison, who has been heretofore managing director, a deed of trust, thereby transferring to him the entire business until the reorganization could be effected. The business will be continued without any delay whatsoever. The company has been doing a large business; so large, in fact, that it required additional capital. The press dispatches announced in effect that the company was financially embarrassed. This report is authoritatively denied.

The company was organized in 1885, with Benson M. Greene, James D. Mason, jr., J. Frank Morrison, William Baxter, jr., William V. Logan, Leopold Strouss and Samuel Rosenthal incorporators. The capital stock was $200,000, which has since been increased to $500,000. The company has three factories in Baltimore which have been run, and will continue to be run, at their full capacity. The company employs almost 400 men.

Pioneer Telegraphy.

The San Francisco *Examiner* printed the appended account of troubles experienced in the operation of telegraph lines. Part of the story may be mythical, but the incidents are interesting at all events. The *Examiner* says:

The callow operator of to-day can lean back in his chair and indulge in a mocking laugh over the troubles which interrupted business between important centers in the early days of the telegraph. About 1865 the best talent of the Pacific coast was nonplussed over a break in the line between Virginia City and San Francisco. The wire carried the stock quotations, and the market was prostrated by the failure to hear from the mines. Stations were a long way apart, seventy miles frequently intervening between operators. Frank Bell was superintendent of the mountain division, where grades were so heavy that linemen had to clamber up the hills by a hand-over-hand process. An inspection did not disclose the break. Another lineman was sent and he returned with the news that the wire was all right. Three days had elapsed without a message between the two feverish markets of Nevada and California, and speculators surmised that some



THE THOMAS MOTOR.

one was playing crooked. Then Frank Bell got mad. He swore that he would go over the line himself and examine every inch of the wire. Then he sallied forth with blood in his eye and a couple of six-shooters in his belt. He fared no better than his predecessors, although he stuck to his resolution to inspect every inch of that wire. Once only did he falter. The wire was stretched across the top of a high hill, where it passed behind a tree. He could see both ends held taut, but not satisfied, he scaled the cliff, climbed in behind the tree, and found the break. The wire, which had parted, had been joined by some one who used a piece of hay rope, thus effectually breaking the circuit. The air was sulphurous about this time and the superintendent wore himself out apostrophizing the man who had done the job.

Nothing was heard of the break until one day during the following summer, when Frank Bell was out making certain repairs. A teamster pulled up his mules on the road below, and shouted to Bell:

"Say, you telegraph feller," he yelled, "I guess you owe me a drink."

"Not by a —— sight," was the positive rejoinder.

"Yes you do," came back from the mule whacker. "I found your old line down here last winter and I tied it up for you."

"Then you are the blasted fool I've been looking for," replied Bell, who began to get hot over the recollection as he started down the bluff.

The teamster saw there was something he could not understand, and lit out without delay.

The Los Angeles circuit of the Southern overland became interrupted in '65. Linemen who were sent out returned, stating that they could not repair the break without a lot of supplies. About a mile of wire and poles had as completely disappeared as though they had been swallowed up by the earth. No trace could be found of the missing material, and the line was reconstructed. Afterward, a detective was engaged to solve the mystery. He worked for three weeks on the case, exploring a country that was a mere desert. He was despondent and about to abandon all further search when he ran across the material in question. He was stopping over night at a small ranch which was surrounded by a neat wire fence. Barbed wire was unknown and the ranchman was taxed with stealing the Overland line. The old settler, who had built a first-class corral at little cost, admitted the impeachment.

"Yes," he said. "I've been living here nigh onto three years, and have watched that durned old line. I never saw anything go over, and thought no one was using it."

The settler was honest, and after reading him a lecture on the invisible nature of electricity the detective reported. No prosecution followed.

On the San Joaquin trail the daring engineers who had climbed crag and precipice to stretch their wires were outwitted by the long-horned Spanish cattle that grazed in the valley. No timber graced the country and flies were troublesome. The cattle were tormented by these winged pests and to get rid of them crowded to the telegraph line. They would rub against the poles and paw the earth away from the base. Heavy poles would be worn out in a few months, causing frequent interruptions. The line could not be fenced in and it would not pay to hire vaqueros to drive away the stock. One of those brilliant ideas that change the fate of nations suggested a cure for the evil. Spikes were driven in the poles and the ends sharpened so as to tickle the thick hide of the steers and keep them away from their daily pleasure. The theory was good, but it failed in practice. The cattle actually appreciated the change and brought all their horned companions from twenty miles to enjoy the prickly sensation produced by the invention.

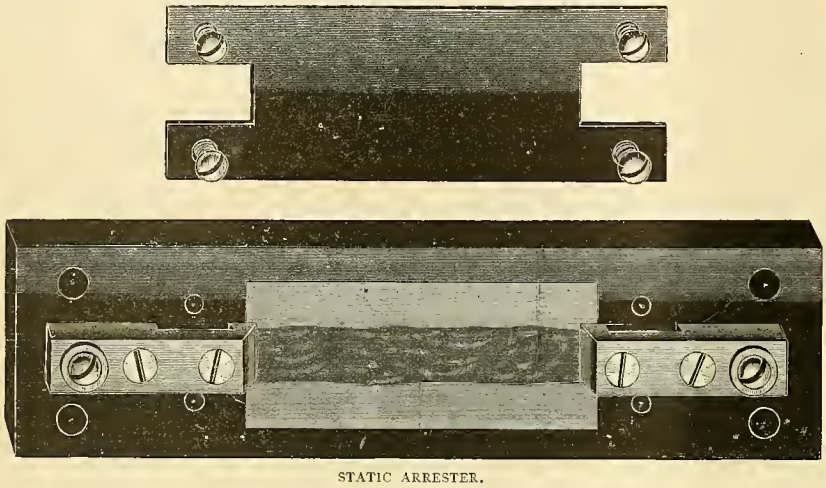
Buffalo Electric Lights.

The special committee of the Buffalo city council appointed to consider the question of the purchase by the city of an electric light plant has reported that it was not advisable for the city to go into this business, provided that the companies of citizens and business men, who were large taxpayers, were willing to accept reasonable returns for their invested capital. The committee expressed disappointment at the bids recently sent in by these companies, and recommended that no further extensions of the lamp district be ordered, and that in all streets where gas is now used, and it is desirable to change to electric light, the incandescent light be used instead of the arc, thereby utilizing the lamp posts and running the wires under ground. The committee believe that the city should not pay more than $1 per 1,000 feet for gas, or 30 cents per light for electric light. The city of Cleveland is furnished with gas at that price, and the city of Dunkirk owns its own plant and lights its streets at a cost of 13½ cents per light per night. In conclusion, the committee recommend that, unless reasonable reductions were made, an act be presented to the next legislature for passage, authorizing the city to establish its own plant.

Static Electricity in Dynamos.

By F. B. Badt.

Static electricity may be accidentally generated in a dynamo in various ways. Generally it is caused by the friction of a dry belt on the dynamo pulley. This static electricity may sometimes prove a source of considerable trouble; and worse yet, very often these troubles may not be traced to their proper origin. It is now a well-known fact that the filament of incandescent lamps will be destroyed by static discharges from belts. Only a year ago the engineer of a large incandescent plant complained to me that there was at least one spot in the wiring system of his engine room which surely had too high potential. An incandescent lamp would not live longer than half an hour in a certain socket. This proved to be the fact, and at first I was puzzled as to the cause until the fact that the lamp was suspended over a dynamo belt gave me the clue. We took a piece of board, covered it with tin, and drove a dozen or more nails through it, thus making a "prime conductor with collecting spikes," and then connected it with "earth." This apparatus was placed under the belt and operated quite satisfactorily in leading off the static electricity to earth. The incandescent lamps suspended over the belt lasted their normal lifetime thereafter.



STATIC ARRESTER.

Recently I had occasion to notice beautiful brush discharges from a new leather belt. I turned off every light in the engine room, and repeated the well-known experiments with incandescent lamps. I would hold the lamps at a distance of about four inches from the belt in various positions, and produce the most beautiful phenomena. Very often it would appear as if the whole lamp was filled with a boiling luminous liquid. The filament of the lamp would be invariably shattered when the experiment was repeated long enough, or when the lamp was brought within one inch of the belt.

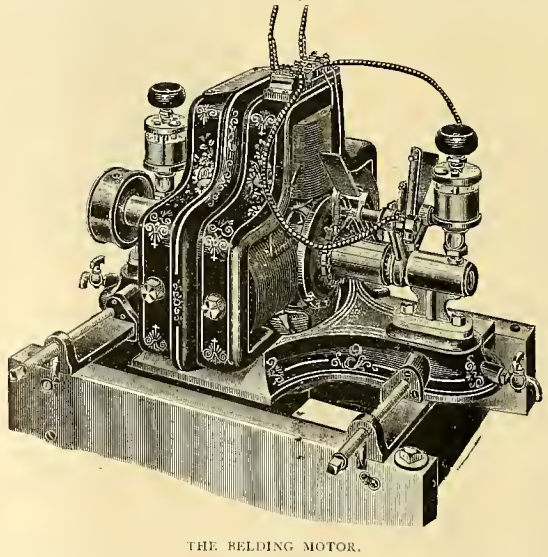
An engineer came to me reporting that "everything" was grounded in his incandescent plant. He could not touch the dynamo, a switch, a wire or a lamp socket without drawing sparks and getting a shock. A test showed the insulation resistance to be above one megohm. When the plant was started, the presence of static electricity was at once manifested. It was conducted to "earth" by means of a similar apparatus to that above mentioned.

Sometimes a dynamo well insulated from earth may be charged like a Leyden jar. The stress may finally become so great that a disruptive discharge will take place, and a spark, in leaping to earth, perforate the insulation of a cable, or puncture the insulation of an armature coil, and connect the wire to the iron core. In one case armatures were continually burning out in a certain dynamo without any apparent cause. It was finally found that the static electricity generated by a belt would puncture the insulation of armature coils, and possibly connect the same coil at two different points to the iron core; the coil thus partly short-circuited of course would overheat and finally burn out. To remedy this evil the static charge was led off by connecting the iron frame of the dynamo to earth. This was done in the following way: The iron frame was connected by a string dipping in a glass jar filled with water. The string being hygroscopic was of course, permanently kept wet. A wire with one end dipping in the glass jar was attached at the other end to earth, thus completing the path for the static discharge. It must be borne in mind that with the high potential requisite to produce static discharges a few hundred thousand ohms are practically no resistance. The wet string arrangement, of course, is very crude, and a little appliance is now made by the Western Electric company which is admirably adapted as a safeguard against the mean tricks played by static electricity. The appliance is called a static arrester, as analogous to lightning arrester.

The static arrester, which is shown in the cut, consists of a hard rubber plate six inches long, one and a half inches wide, and three-eighths inch thick, on which a little mica plate three and a half inches long is held by two small brass clamping plates. These are provided with screws and washers, serving as binding posts. The upper surface of the mica plate is roughened with sand paper, and then a layer of graphite deposited throughout the whole length of the mica plate by means of an ordinary lead pencil. This thin layer of graphite is at both ends in contact with the brass binding plates, thus forming a conductor of high resistance between the binding screws. The resistance, of course, can be made anything desired. In order to comply with the underwriters' rules, the resistance is generally made one megohm. The mica plate is then varnished and covered by a plate of hard rubber to protect the thin graphite layer. One terminal of this apparatus is connected to the iron frame of the dynamo, and the other to earth. If in a high potential dynamo a wire coil should get in contact with the iron frame, and at the same time one of the outside conductors become grounded, a great difference of potential might exist between these two points, and such a flow of current take place through the static arrester that an arc across the graphite resistance space would be formed. In order to prevent this, it is advisable to insert a few feet of say, number 30 B. & S. bare copper wire between the static arrester and the earth wire. This thin wire would act, by timely melting, as a safety plug, while its carrying capacity would be amply sufficient for the static discharge.

The Belding Motor.

The Belding motor is illustrated in the accompanying cut. The form is compact and substantial. Every part is made interchangeable, even to the commutator, which can be removed and easily replaced in twenty minutes, without disturbing the armature connections in the least. This, as will be readily seen, is a decided advantage. For incandescent circuits the motor requires no mechanical governor. By the ratios of the winding it is made almost automatic, and the speed varies less than 1 per cent. when the motor is carrying its load, or running wild. Two brushes are employed, but it is claimed there is no sparking. The annexed cut illustrates a ½ horse power motor. The machines are constructed up to 25 horse power. They are put on the market by the Belding Motor & Manufacturing company of Chicago.



THE BELDING MOTOR.

Motor Power Wanted.

The *Times* Publishing company of Dallas, Tex., has begun suit against the Dallas Electric Light, Power & Manufacturing company. The complainant alleges that the defendant's president and manager informed the plaintiff that its company would furnish the plaintiff electric power to run a 4 horse power electric motor, and operate its printing machinery ten hours daily, for $45 a month, as long as the plaintiff needed the power, beginning on the 1st of November, and if desired would furnish the same power by night at the same price per hour; that the plaintiff accepted the defendant's terms, and disposed of its steam engine and purchased at a cost of $440 a 4 horse power Baxter electric motor, which it had placed in position; that on the 1st of November "the defendant being fully advised of the great loss and damage which would necessarily result to plaintiff's said business, upon defendant's failure to faithfully comply with its contract, attached its wires to plaintiff's motor, upon which to convey the current of a size too small to convey sufficient power." Plaintiff claims $1,788.95 actual damages and $3,000 exemplary damages.

Incandescent Lamps for Street Lighting.

The city electrician of Buffalo recently investigated the use of incandescent lamps for street lighting in Rochester. Following are extracts from his report to the common council: The outskirts of the city are lighted by the Edison municipal system in the following manner: They utilize the lamp posts belonging to the city, and place 20 candle power incandescent lamps upon them; the wire is run from lamp to lamp through the trees, no poles being used where there are lamp posts. The cost of the lights to the city is 5 cents per lamp per night from sundown to sunrise, or $18.25 per lamp per year. These lamps are from 150 to 180 feet apart. I am indebted to the city clerk for the information that one of the Edison 20 candle power lamps equals about 1½ gas lamps, and that the streets are better lighted than with gas at the cost of oil; he thinks, however, in main streets where there are no obstructions, such as foliage of trees, etc., that the arc light is better, providing that they are close enough together. In some of the streets I found only three lamps to each block, yet they were fairly well lighted, but one street that was lighted with lamps 100 feet apart was well lighted; that is, there was no intense light at the intersections and darkness in the center, as with the arc light, but the light was evenly distributed over the entire block and placed where it would do the most service; viz.: below the obstructions. The foliage of the trees is not allowed lower than 14 feet from the sidewalk.

Electric Lights at Suakim and the African Cables.

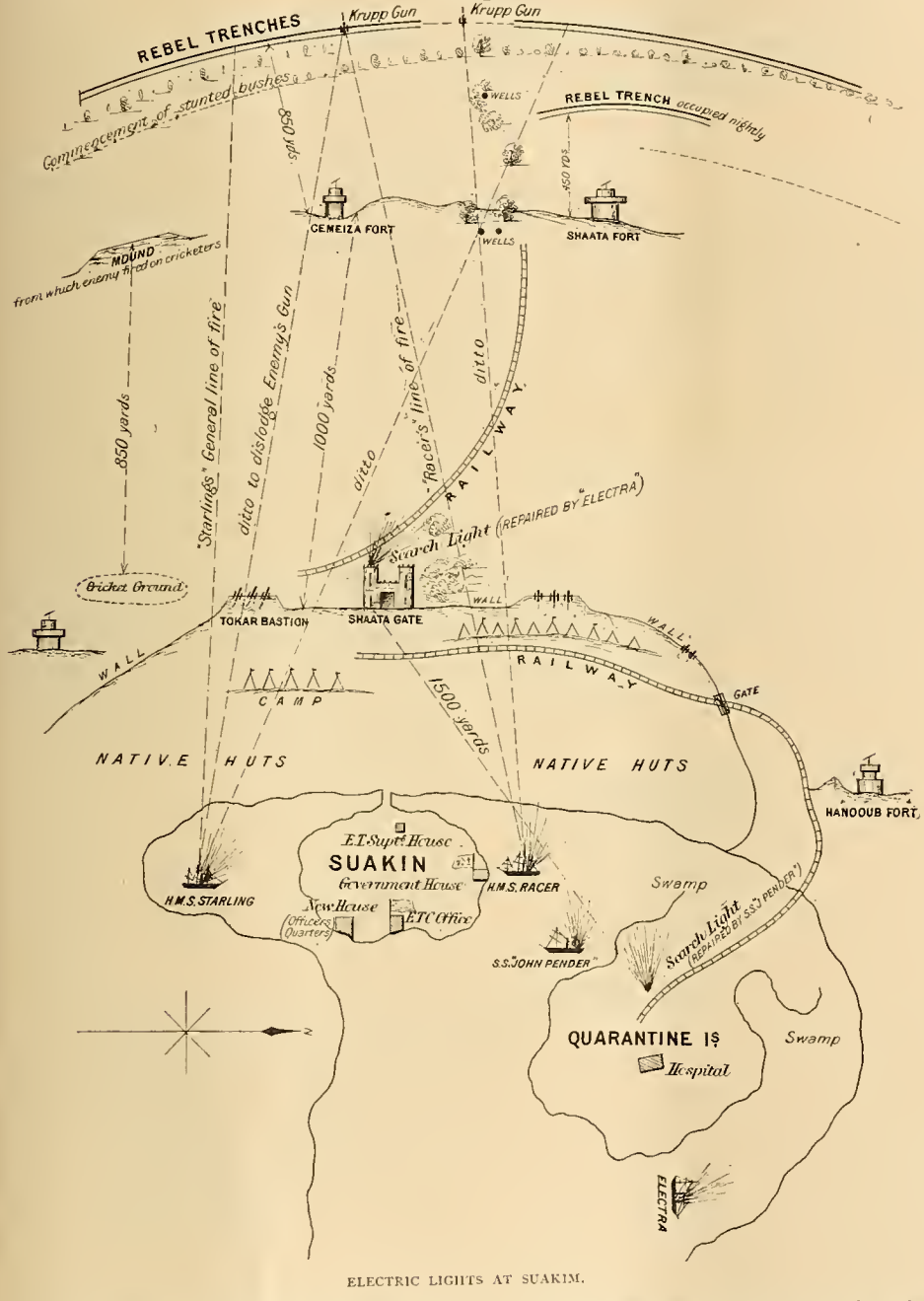
The newspapers of last week contained cable dispatches sent from Suakim, giving accounts of the fighting at that point. It was stated that a detachment of British troops which had arrived at Suakim had been fired upon by the Arabs, who employed their artillery with considerable effect. They were quickly silenced by shots from the forts and the steamer Racer. The extension of the cable system along the African shores is emphasized by the rapidity with which news is received from Suakim. The London *Electrician*, in an article on the African cable system, says:

"The fact that in the space of ten years Africa should be almost completely encircled by the telegraph affords a striking example of the rapidity with which submarine communication is being extended. It may be said that the eyes of all Europe are turned to the Dark Continent, and that all the nations are interested in its development. In view of the immense possibilities of its future, it is interesting to note the commercial enterprise which has connected telegraphically all the important points on its coast with the rest of the world at a time when only an infinitesimal portion of its immense territory has been brought under the influence of civilization."

In connection with this article a cut, giving a plan of the works at Suakim, is printed, which illustrates the value of electric lights in warfare. The cut is reproduced herewith. The article continues:

"The state of affairs at Suakim is an instance of the 'surf which marks the edge of the advancing wave of civilization,' as Lord Salisbury said the other day."

A correspondent on the spot says: "There is not the slightest doubt that leaving Suakim without the protection of men-of-war, after H. M. S. 'Dolphin' and 'Albacore' clearedout on the 17th of July, owing to heat and sickness, and allowing the electric light to fall into disuse, are the causes of the dilemma we are now in. Earthworks sprang up over night as if by magic, which could not have happened had the electric light been kept in order.



ELECTRIC LIGHTS AT SUAKIM.

"After a cricket match the other evening the sentry telephoned in: 'Tent gradually moving westward,' and before things could be made clear the tent (which had been left on the cricket ground), and under which the rebels had got and cut the ropes while keeping it open by their numbers, was carried bodily away under the very noses of the fort gunners, who could not believe their eyes."

It will be remembered by readers of the daily papers that the light on Quarantine Island was repaired by the staff of the Eastern Telegraph company's steamship, "John Pender," and that on Shaata Gate—which is the more important, being 1,500 yards nearer the trenches—by the officers of the same company's steamer "Electra."

The plan which we give is from a sketch by the electrician of the latter vessel.

Cable Operators.

To work the vast lengths of submarine cables a good-sized army of operators is employed, says the St. Louis *Post-Dispatch*. Not much has been written about these men, but these deep-sea cable operators constitute one of the finest bodies of skilled workers in the world. All the cable lines are manufactured and owned in England, and the operators are almost without exception, Englishmen. These cablemen are brave, fearless and far above the average intelligence. They never flinch from going where duty calls them, and they are most important factors in commerce, diplomacy and provincial government. They are great travelers, and numbers of them have been in every part of the known world. The deep-sea cablemen are taught the rudimentary elements in London. They are then sent to Porta, Kurno, Penzance, where they become familiar with the working of the syphon recorder, the spark and the transmitter. When proficient they are detailed to any place touched by cable. These operators are well paid, work short hours and very seldom leave the service. They are called upon to work in the deadly fevers of Panama and Africa, to face wild beasts in India, to work among prowling bands of robber nomads in Arabia and Persia, they must live in the cholera stricken cities of Siam and China, the yellow fever of Cuba, the torrid climate of South America, and the bleak coast of Eastern Siberia. But in spite of the fact that the cable lines are laid through such pestilential countries, the mortality rate among the cable operators is very low. This is no doubt due to the fact that the companies are continually changing their men about in such places. An operator is detailed to very unhealthy places for six months or a year. He is then sent to some very healthy spot. Men are often transferred from Panama to Nagasaki, or Cape Town.

To keep these vast lines in order a number of steamships are fitted up for that purpose and the men spend a few pleasant months on board them, taking turn about. If an operator marries and locates in a place he is allowed to remain there. The men live a very pleasant life, except when they are detailed to dangerous and unhealthy stations. The men always rely on the protection of the home government, and they fearlessly go to stations in the wildest spots of Arabia, Turkey, Persia or Africa, conscious of the fact that if the natives molest them a British gunboat will soon make things howl in that vicinity.

The largest force of operators is kept at the repeating stations, where all messages have to be transferred. At Sucz and Aden sixty cablemen are employed at each station. On the American side the largest force is at Heart's Content, Newfoundland, where there are forty men. This is a steady colony of cable operators. Nearly all of the older men are married, and are bringing up families. They have a chapel, school, clubhouse, and own their own houses. At the cable stations the company builds several buildings, including the office, a clubhouse furnished with a piano, billiard table, card room and all conveniences. Single men live here. Marriage is encouraged; and when a man marries he is given a small house, his fuel and the doctor's services, all free. Life is made as pleasant as possible, and the stations are furnished with boat-houses, sail and row boats and firearms. The men are given thirty days' vacation, with pay, yearly. The leave is cumulative, and if a man works five years he is given five months' leave and his passage to whatever part of the world he may live in. The cablemen are regarded as a species of supernatural beings by the different wild tribes in outlandish countries.

B. Howard Haman entered suit in the Court of Common Pleas, at Baltimore recently, for the Western Union Telegraph company, against the Brush Electric Light company for alleged interference and obstruction of the plaintiff's business. The complaint charges the defendant with unlawfully usurping and taking possession of the plaintiff's poles for its uses and purposes, and that the electric light wires constitute a continual source of danger and menace to the public and to the plaintiff's employes; repairing the wires they are compelled to come in close proximity to the wires of the defendant. A writ of mandamus is asked for commanding the defendant to remove, within a certain time to be named therein, all the electric wires which have been strung upon the plaintiff's poles, and a writ of injunction forbidding the defendant, or any of its agents, from putting any more wires thereon. The damages are laid at $5,000.

Practical Telephony.

By Thos. D. Lockwood.

PART XV.

The arm *J* has flat sides and is hollow, being really made of two pieces which are screwed to one another. The arm itself is jointed to the bracket of the box *K*, and has a screw with a milled head which can be tightened to prevent the joint from working loose.

The transmitter proper is in turn jointed to the arm at its free end. Inside the arm, and shown in the section Fig. 23, is an iron rod *R*. This has a hole which works on a pin on the bracket, and the other end is similarly mounted on a pin fixed to the joint lug of the transmitter *B*. The rod is thus attached at one end to a fixed point, and at the other end to a movable point, and is of course, non-extensible. As it is clear that the outermost end of the rod must always be at the same distance from the fixed point, irrespective of the elevation or depression of the arm, it is also clear that this fact it is, that determines the uniformly vertical position of the mouthpiece. For, suppose the arm to be at its highest position and then to be depressed; if the rod *R* were not present, the mouthpiece would depart also from its vertical position, and would present its flare on a downward angle. On the other hand, under the same conditions, suppose the arm originally to be at its lowest point, but with the mouthpiece vertical; if it be raised, the mouthpiece will rise with it, and will constantly trend to horizontality, the flare being upward. But since the rod *R* is actually present when the arm is depressed, the outer end of the rod exercises a steady push against the joint lug of the transmitter, preserving the vertical presentation of the mouthpiece; while if the arm is raised, the rod pulls instead of pushing at the transmitter, and the result is the same. The device is, in fact, simply the well-known mechanical appliance which we call the "parallel motion." The spring and link which in the figure are at one end fastened to the stationary lug and at the other end to the parallel motion rod, simply act to keep the arm at any point where it may be placed.

Now let us examine the electrical conditions of the case. In any battery transmitter the variable resistance or current changer is of necessity included in a battery circuit. And, as explained in the earlier chapters of this series, this circuit is usually in practice caused to include the short, coarse wire, or primary circuit of an induction coil. Such is the case in this transmitter. The induction coil is a little larger than that of the Blake transmitter, and is inclosed in the box *K*. A cross sectional view of it is shown in Fig. 23. The inclosing box has four screw terminals at the top side which represent respectively the two ends of the secondary and the two ends of the primary coil. The platinum diaphragm is in metallic contact with the metal of the casing and arm, and the arm thereby serves as one side of the circuit; the other side of the circuit being the flexible conductor *F*, which extends from a binding screw in metallic connection with the transmitter cap and pendulous electrode to a second screw on the lower side of the box *K*, this being insulated.

By means of suitable contact springs within the box, the two conductors leading from the granulated carbon, connect, one with one terminal of the primary coil, and the other with one wire of the battery. The other battery wire is connected also by means of similar screws and springs with the remaining coil wire. In the drawing there is a slight error, and the upper binding screw like the lower one, should be insulated from the casing.

The Bell Telephone company of Canada has adopted a style of adjustable transmitter for long distance work, which is shown in Fig. 25. The transmitter and induction coil parts are in every essential the same as in the instrument I have described, but the adjustable feature is of a different pattern. It will be seen that in this style the induction coil case *K* is set upon end, and is provided with a pair of lugs in which an upright iron rod *L* is fixed.

The transmitter *D*, so far as its internal arrangements are concerned, is the same as that already described, but the stem terminates in a vertical sleeve. This slides on the upright *L*, which is longitudinally grooved as at *M*.

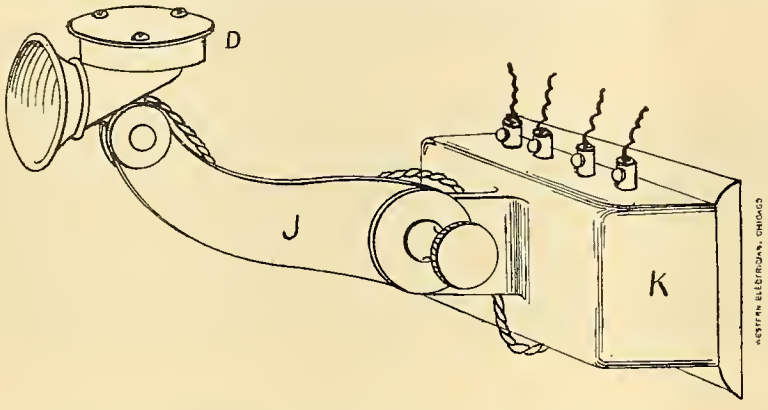


FIG 23.

A set screw *N* passes through the slide of the sleeve and engages with the groove *M* to hold the transmitter in place at any height to which it is elevated; it also keeps it from turning round.

I rather prefer this form, as it is less costly in construction, extremely simple, having nothing concealed, and it is withal of equal efficiency to the more complicated parallel motion arm.

A modification of the buried sieve electrode of Mr. Blake's transmitter is also to some extent used, and is indicated by the cut, Fig. 26. In it the complementary electrode is made of a netting of gold-plated wire gauze, which, however, is not stretched or clamped in any way at its edge, but simply is fastened to a support at its center; which support hangs from a kind of metal web, resting upon the upper edge of the inclosing non-conducting ring. The upper electrode is thus pendulous, and yet is completely buried in carbon granulations. The casing and mouthpiece are made and put together just as in the other forms which have been described, and the pendulous electrode is caused to form a part of the circuit by the pressure of the screw-cap upon it.

It should be stated that in all forms of long distance tranmitters made in this general style, the complementary electrode should be plated with gold or some non-oxydizable metal, or should be of hard carbon.

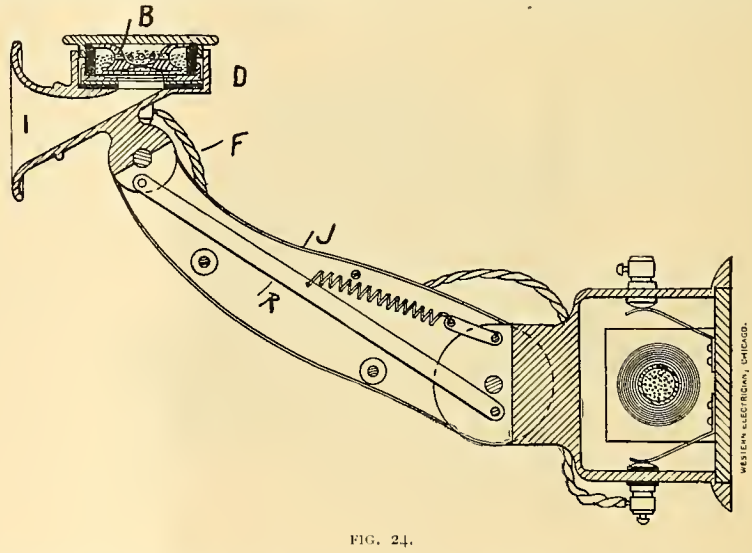


FIG. 24.

Now I come to the habits and requirements of the instrument. In the first place, its contents must be loose. If complaint be made that it does not transmit with sufficient loudness, generally a few smart but not violent raps with the fingers should be given, which will probably separate the packed particles and start up the sound. Not infrequently a loud vocal utterance, for example, a musical note directed into the mouthpiece will give the diaphragm sufficient vibration to properly distribute the granules. There seems to be a strong temptation, which invariably besets a subscriber in whose hands this transmitter happens to be placed, to poke the diaphragm with the sharp end of a pencil or a stick, or in fact anything that comes handy. I grieve to say that I have even known inspectors and emissaries of telephone companies, who were addicted to this practice. Now this temptation should in all cases be resisted.

The diaphragm is only a very thin and very fragile piece of platinum foil, and ought not to be treated as an attendant in a menagerie treats a wild beast. It never does and never can do any good to poke the near side of a long distance transmitter diaphragm, and I would respectfully say, "Don't do it."

So frequent has this practice become, that it has been found necessary to put up a partition of crossbars inside the mouthpiece to intercept any instrument of violence aimed at the diaphragm. Another cause of weak talking, or talking of insufficient volume, lies often in the battery. I have already, in the earlier portion of this series of papers, devoted some attention to batteries, and have it in mind to say something more on the same subject later; it is not therefore necessary now to speak at length thereon.

It is sufficient to say that for a long distance transmitter considerable electromotive force as well as a considerable volume are required. To get the necessary e. m. f., it is well to use three cells irrespective of the kind of battery employed. Three cells of a good potassic bichromate battery supply both the e. m. f. and quantity required, and will last without attention for some three or four months, according to the amount of work. The Fuller battery I have found to give the best results. But it would not ordinarily be judicious to supply an acid battery to subscribers on many accounts, although for use in the rooms of telephone officers there is nothing in my opinion so good. For subscribers' use, in connection with this transmitter, four sets of Leclanche in series answer well, but care must be taken at the outset that they are good cells; for not every battery that uses peroxide of manganese as a negative plate, or as a depolarizer, is entitled to be called a Leclanche cell. I have also found the so-called Samson cell and the Gassner dry cell to give good results. In batteries of the Leclanche type, attempts have been made to secure the necessary amount of current (which otherwise is not up to the mark by reason of the comparatively high internal resistance of these cells) by coupling two series of two to

three cells each in multiple arc; but this practice is not to be recommended, as one series nearly always differs in power in a short time from the other, and then the current from one side—the strongest—begins to back upon the cells on the other side, to the detriment of both. The better way, and the way practically adopted by the Samson type, is to make the cells larger, bring the plates closer together, and thus lower the internal resistance by increasing the surface, and shortening the length of fluid distance between the plates.

Another important point is to see that where

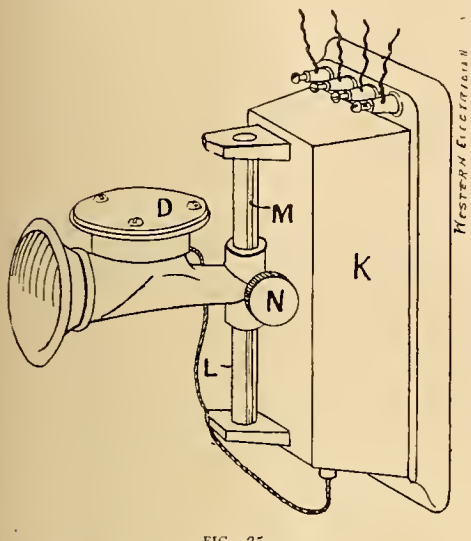


FIG. 25.

porous cups are used, that they are really *porous*, and not glazed.

Many a cup is so hard that it is no misapplication of terms to call it water tight, and has given an otherwise good battery a bad name. Too much care cannot be bestowed upon this feature of the cell.

When a usually good working instrument begins to work spasmodically, sometimes well and sometimes badly, and varies materially during a single conversation, it is safe to assume that there is something wrong with the battery connections, and it will do no harm to look at it or them, and occasionally, in any event, to make an examination for loose connections. Loose connections, also, will sometimes show themselves in other parts of the instrument, and therefore all screws and flexible conductors ought to be frequently tried. In this class of instruments as well as in ordinary subscribers' station instruments there is decidedly too great a tendency to assume in case of any fault in line, battery or instruments, that the fault is certain to be located in the transmitting instrument. No greater error in telephone work ever existed, than making the transmitter the scapegoat for the entire system. It has enough transgressions and delinquencies of its own without being made to shoulder those of other parts of the organization.

Everybody wants to see the "wheels go round," and it seems also as if everybody that operates a long distance transmitter wants to see inside. Generally speaking, there is rarely any use in opening or unscrewing the instrument; and none but those who are experts in telephony should undertake to do it. But there are occasionally times when a pulling apart and replacement of the several parts tends to better work. The three screws of the flat upper face of the instrument hold all the parts together. When these are taken out, and the tag of the short flexible cord removed from its binding screw, the cap and upper electrode can be lifted off, after which the non-conducting cup floored by the diaphgragm and its metal seat can be lifted out, easy pressure being applied to the screw post below.

The granulations can then be emptied upon a sheet of writing paper.

In putting the parts together be careful to note that the diaphragm and its metal seat have no accidental contact with the metal casing. The diaphragm seat may, if tarnished, be rubbed up with a piece of very fine emery paper and then dropped back into its place, the binding screw forming a guide as it passes through the hole.

Then examine the platinum foil diaphragm, and if at all wrinkled, smooth it out with a handkerchief placed over the end of the forefinger. When perfectly smooth, lay it in place in its metal ring. Now insert the hard rubber or vulcanized fiber ring, as indicated in Fig. 26. Upon this place the upper electrode and hold it in place with the thumb and finger, and carefully pour in the carbon.

Shake it down once or twice, and finally leave the carbon just about half filling the funnel-shaped cavity in the standard electrode. Lastly replace the cap, and carefully screw it down, taking care to screw up the several screws a little at a time, and not to screw one of them tight before going to the others. But in all cases when a long distance transmitter is working well, leave it alone.

(*To be Continued.*)

The Book Table.

FORTSCHRITTE DER ELEKTROTECHNIK (Progress of Electrotechnics for the year 1887). By Dr. Karl Strecker; published by Julius Springer, Berlin; 282 pages, 7½ x 4½ inches.

The object of this book, of which one part is published every three months, is to give a summary of all articles descriptive of new electrical appliances contained in the electrical papers of Germany, Austria, France, Italy, England and America. Each quarterly number is divided into the following chapters:

Electrotechnics—

I. Dynamos, Electro-Motors, Regulators.
II. Distribution and Conductors.
III. Electric Lighting.
IV. Electrical Transmission of Power.
V. Various Applications of Electricity.

Electrochemics—

VI. Primary Batteries.
VII. Secondary Batteries.
VIII. Applications of Electrolysis.

Electric Telegraphy and Signaling—

IX. Telegraphy.
X. Telephony.
XI. Electric Registering Apparatus and Clocks.

Measurements and Scientific Researches—

XII. Galvanism.
XIII. Magnetism, Induction, Capacity.
XIV. Measurements of Lamps.
XV. Electrochemics.
XVI. Theoretical Researches.

Atmospheric Electricity—

XVII. Atmospheric Electricity, Lightning Arresters and Lightning.

Review of New Books—

The contents of no less than seventy-six electrical newspapers and other publications, including the official German and United States patent office Gazettes, are thus recorded.

For the student in the electrical field this book is almost as indispensable as Webster's unabridged is to the student of the English language. It not only gives a synopsis of any article to which he may wish to refer, but it gives the number of the periodical in which it was originally published. The work cannot be praised too highly. Unfortunately, it is only published in the German. The headings of the articles originally published in the English language, however, are given in English, and thus the book may be serviceable even to one unacquainted with German. The type used in this book is Roman. The German type has so often proved an obstacle to non-German students that of late years almost all scientific German works are printed in Roman type.

DIE ERZEUGUNG UND VERTEILUNG DER ELEKTRIZITÆT IN ZENTRAL STATIONEN (Generation and Distribution of Electricity in Central Stations). Two volumes: Vol. I, 174 pages and 56 illustrations, price 4.50 marks; Vol. II, 371 pages and 137 illustrations, price 8 marks. By Dr. Martin Krieg. Published by A. & R. Faber, Magdeburg, 1888. Size of type page, 6 x 4 inches.

In the first volume the author treats very clearly of the most important types of alternate current dynamos and transformers. He describes the distribution for arc and incandescent lamps, and then takes up the different types of voltmeters, ammeters and current meters. He concludes with a consideration of the theoretical investigations in relation to alternate current dynamos and transformers pursued by Hopkinson, Kapp and Thomson. The second volume treats of direct current dynamos. Interesting data are given concerning several European systems little known in the United States. The author also considers accumulators, systems of distribution, conductors, instruments, construction, and the running expenses of central stations. Plans and detailed descriptions of some large American and European central stations constitute the last chapter. The book can be heartily recommended.

Trial of the Alternating Current Motor.

A Pittsburgh paper says: The Westinghouse Electric company has completed arrangements for the construction of an electric railway around the extensive works on Garrison alley. The railway will be built for the sole purpose of making a practical demonstration of the efficiency of the new alternating current motor in propelling street cars. A car of the standard size will be used and fitted up to carry passengers, so that the test will be thorough. The car will be run under all imaginable conditions for the purpose of ascertaining, if possible, whether any emergency could arise that would render the motor uncontrollable.

The Copper Trust.

Mortimer McRoberts of Chicago, who deals extensively in copper, recently said of the importance of the fire in the Calumet and Hecla mine: "If it is as bad as reported in the papers yesterday the mines will be closed for at least a year, and there will be no production of copper from that source for at least twelve months. Now, then, the French syndicate is decidedly in a bad way; you see it is overloaded. In fact, it has more copper than it wants. That syndicate has the Anaconda mine in Montana, which is the largest in the world. It agreed to pay 13½ cents per pound for copper at the mines, and now charges brass and copper manufacturers 16½ cents. Now look at the iniquity of this thing. In May, 1886, copper was 10 cents a pound. In June it ruled a little higher, and in July of that year it averaged about 10 cents, and copper mining paid well at that price. In May, 1887, before the French syndicate created a trust, copper sold at 9½ cents, and in June it sold at 10 cents. Then came the trust, and in July copper commenced to go up until in the month of December it reached $16.90 per 100 pounds. This rise in prices was not for the benefit of working men, but for a gigantic trust composed of foreign capitalists. Nothing so outrageous as this mammoth imposition has ever been foisted upon the people, unless you except the hard coal combination. Now, copper, since the syndicate has controlled it, has been as high as 20 cents. There is no other country under the sun where such outrages could be perpetrated. It is one of the remarkable points of the beauty of our tariff laws. There is no copper to be had except through this French syndicate. That fire is a big thing for the syndicate. It will send up the price of copper, of which it has got a large stock on hand. It closes this mine for the time being, and

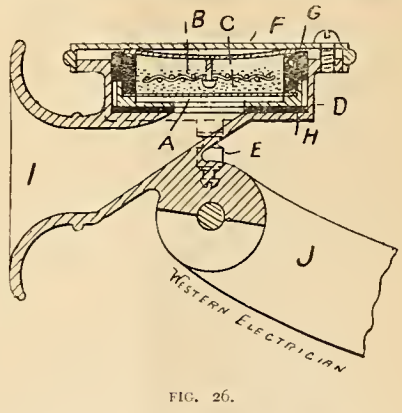


FIG. 26.

as it only pays for actual production the stockholders of the Calumet and Hecla will be the only direct losers. In September the production of copper was 8,000 tons more than could be disposed of. This will now be sold. The surplus copper is sent to London, but the market there has also been slow. That fire was a big thing for the syndicate. There is no doubt about that, but how it was started I am not prepared to say. The monopoly is very strong, however, and prices will be forced up several notches."

At the meeting of the St. Paul, Minn., common council November 20th, the committee on gas, to which was reported the resolution abolishing the electric lights of the city, except in public buildings, reported adversely, with an amendment to the effect that all electric lights in public parks be discontinued After a good deal of talk, the original resolution abolishing all the lights came up for passage. A vote resulted in a tie, seven voting on each side of the question, and the resolution was accordingly declared lost. The amendment of the committee on gas, abolishing the park lights, was then taken up, and passed by a vote of 10 to 4.

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CONTENTS OF THIS NUMBER.

PAGE.

Thomas Electric Motor, Illustrated 301
Fort Wayne Jenney company 301
Baxter Motor company 301
Pioneer Telegraphy 301
Buffalo Electric Lights 301
Static Electricity in Dynamos by F. B. Badt, Illustrated 302
The Belding Motor, Illustrated 302
Incandescent Lamps for Street Lighting 302
Electric Lights at Suakim and the African Cables, Illustrated 303
Cable Operators 303
Telegraph Lines and Electric Light Circuits 303
Practical Telephony by Thos. D. Lockwood, Illustrated, Part XV 304, 305
The Book Table. 305
Trial of the Alternating Current Motor 305
The Copper Trust 305
Editorial 306
Magneto Call with Manual Telephone Switch, Illustrated 307
Sprague Road at Cincinnati 307
Tests of Pentane Lamp by W. Stepney Rawson 307, 308

DEPARTMENTS.

Correspondence 308, 309, 310
The Electric Light 310
The Electric Motor 310, 311
The Telephone 311
The Telegraph 311
Electrical Patents 311, 312

THE views of a Chicago dealer in copper are given in another column. Many predictions have been made that the trust would soon come to an end, but recently it has manifested signs of the greatest vitality.

AN article is presented in this issue showing, in connection with a map, the use of electric lights by the English in their operations at Suakim. The value of electric lights in warfare is becoming well recognized, and is emphasized by their employment in Africa.

IT is stated in another column that electric lighting has increased 200 per cent. in New York city the last year. It has been stated at different times that the action of the Board of Electrical Control has greatly discouraged the companies, but the figures would not seem to justify the statement.

PROFESSOR BADT, in his article on the "Static arrester," tells, in a practical way, some of his experiences with static electricity, and he describes several of the simple temporary devices he has employed to prevent damage from this cause. He gives a description of a permanent arrangement which is used to prevent the disastrous results caused by disruptive discharges.

A NOTE which is going the rounds of the press states that the duchess of Marlborough, formerly Mrs. Hamersley, has introduced the electric light in one of her husband's palaces. If the duke had not married an American wife, the magnificent building would have been lighted by candles or gas for decades. Americans are enterprising, and they have a just appreciation of the beauties of the electric light.

IN the letter from Topeka a description is given of the trial of the use of oil as fuel in the electric light station in that city. The experiment seems to have been entirely successful. The use of oil as fuel is becoming more general every day, and the subject is one of peculiar interest to electric light companies. If reports are to be believed, the experiments have been almost without exception successful.

EXPERIMENTS in New York have demonstrated that the electric motor is adapted particularly well to use on elevated roads. Almost every large city in the country has before it a plan for elevated roads. Chicago at the present time is blessed with a score or less of "L" road projects. The gentlemen interested in these proposed roads have stated their preference for an electric system if it could be demonstrated that steam could be displaced successfully. The progress of the New York experiments will be watched with interest.

THE telephone controversy came up for consideration at the last meeting of the Chicago city council, Monday evening. An order was presented on behalf of the judiciary committee directing the commissioner of public works to refuse to grant permits to the Bell Telephone company to exercise further privileges in this city until otherwise directed by the council. Alderman Rix moved the passage of the order and the motion was adopted. This is the first step in the war which the council proposes to wage with the Chicago Telephone company. It refuses to grant applications made in the name of the present corporation or of the parent company.

IT will be noticed in the correspondence columns that a decision in the litigation between St. Louis and the telephone company in that city is expected December 20th. The determination of the questions involved in that controversy is of the highest moment to every telephone company in the country. The principal point at issue is the question of the right of the municipality to regulate telephone rentals. The decision of the Missouri Supreme court will be regarded as a precedent. If the result is unfavorable to the company, it is not unlikely that many city councillors will follow the example of the St. Louis aldermen, and reduce rates in their respective cities.

IN this issue Mr. Lockwood continues his series of articles on practical telephony. The description of the long distance transmitter is concluded, and then, as the author says, he takes up the "habits and requirements of the instrument." He follows with instructions for remedying the disorders to which the transmitter is subject, and incidentally gives some very plain advice to the users, as well as the inspectors, of the long distance telephone. The branch of the subject which Mr. Lockwood is now treating is of special interest at the present time. An article quoted in another column from a daily paper indicates the very general interest which the public is taking in the long distance telephone.

THE operations of the copper trust are just now claiming a large share of public attention, and the syndicate daily receives very hearty abuse in the press. The last report concerning the copper supply comes from Butte, Mont. A dispatch says that the large smelter of the Anaconda company has been closed down indefinitely. The fires in the furnaces have all been drawn. Over 1,500 men are thrown out of employment. This necessitates the discharge of all the men working at the Chamber's syndicate mines, the Anaconda and St. Lawrence, at Butte City, which, combined, give employment to 2,500 more. No reason is assigned for the shut-down. Manager Daly would state no reason only that J. B. Haggin of San Francisco had telegraphed to close the mine and smelter for an indefinite time. The general opinion is that in view of the fire in the Calumet and Hecla in all probability the contract of the copper syndicate will be extended twelve years more, and hence the shut-down of the mines to further that end.

IN an article on the future of electric tramway traction, the London *Electrical Review* points out the advantages incident to the employment of storage batteries. It regrets that a sufficient number of cars has not been equipped by a London company to demonstrate the exact cost of working. It adds that this is the only thing which keeps electric traction from becoming universal. "There is not the slightest doubt," it continues, "that when a line is once launched in this country, with a sufficient number of cars under proper management, tramway directors will speedily alter their cold and motionless countenances. Let us hope that this may soon be the case, or our American cousins will have to come over here and do the work for us."

COMMODORE J. G. Walker, chief of the bureau of navigation, in his annual report, calls attention to the subject of introducing electric lights into naval ships. The first man-of-war in the world, says the report, to be lighted by electricity, the Trenton, was installed under the direction of this bureau, under an appropriation especially asked for by the bureau for that purpose. From the first this mode of lighting has been successful, and it is now conceded that no ship is complete without electric lights; they have been proved beyond a doubt to exert a direct and salutary influence upon the sanitary condition, the discipline, and the efficiency of vessels of war. By placing the entire subject of electric lighting in the hands of one expert inspector, it is stated, great progress has been made in perfecting the special appliances required for installing ships. The new ships now being lighted will have very superior installations.

THE equilibrium of the London *Electrical Review* is again disturbed by a new exemplification of American "smartness." The *Review* took occasion lately to define what it is pleased to term American "smartness," and in doing so referred to "wooden nutmegs and clocks that wont go." It has just had, however, a very practical definition of the term. An enterprising American electrical company has just captured the contract for lighting the city of London, and the distress of the poor old *Review* over the matter is very touching. In reference to the fact that the contract, amounting to something like $300,000, has been given to an American concern, the *Review* says: "Many people will feel disgusted that the technical advisers of the Metropolitan Electrical Supply company should have allowed an order of this kind to go across the water. It will seem to some that it is an insult to English engineers, for things are bad enough here without our own men passing us over. It is not as if we would or could not do the thing decently. Foreign competition would no doubt come in any case, but we surely need not send for it. Our learned professors dabble far too much in these commercial matters, and should have their fingers rapped. It must not be supposed that we are commenting upon this topic in a spirit of pique at the contract having gone out of the country, for we do not think it will be gainsaid that English enterprise in the States is far greater than the Americans can give us any equivalent for here, and has not a Ferranti plant already found its way across the Atlantic? The circumstances, however, under which this business has been transacted appear to make it desirable that a little more light should be shed upon the matter, if only for the sake of pacifying the angry feelings to which it has given rise in electrical circles." Oh, no, of course the *Review* is not commenting on this matter in a spirit of pique; but by the way, gentlemen of the *Review*, how do you like this latest definition of the term which you are so fond of using in connection with American enterprise? You may rest assured that the apparatus which the American company will furnish to the city of London will not be of the "wooden nutmeg" order, and it will "go," and this, of course, will add still further to your distress.

Magneto Call with Manual Telephone Switch.

The accompanying cut illustrates a magneto call with new telephone switch and arrangement for factory call service. The switch is operated by hand, thus insuring firmer and more perfect contact. There is no more chance of forgetting to operate the switch than in the case of the ordinary instrument. By reference to the cut, it will be noticed that the hook supporting the telephone is fastened to a slotted plate which is attached to the box. The hook and plate remain stationary. Protruding from a slot in the plate is a lever, a part of which is inclosed in the box, and extends across to the opposite side. It is fastened to a bracket on the side of the box. The lever from this fastening to a point an inch or an inch and a half from the point where it protrudes is flattened, forming a spring, which causes the outer end to rise to the top of the slot in the plate over the hook. From the inner end of the lever a wire extends to the telephone, to the secondary coil of the transmitter, and thence to a binding post. To this post either the outgoing or ground wire is attached.

When in use the telephone is removed from the hook, and the lever pulled down and caught in the place in the plate provided for it. The lever now connects with the outgoing line, disconnecting it from the circuit through the bells and generator. The lever also closes the battery circuit through the transmitter. The telephone cannot be released without first unclasping and allowing the lever to spring up to place, as shown in the cut, thus uncovering the hook. With this arrangement the weight of the telephone has nothing to do with making the connections, consequently the spring can be as stiff as desired, thus insuring perfect contacts.

The push buttons shown below the call box are for factory call service, and are brought into circuit with the generator by pressing on either one and turning the crank. The binding posts above the box are for wire connections to different parts of factories, with the exception of two right-hand posts, one of which is for telephone central connection; the other for outgoing or ground wire. Pressing one of the push buttons and turning the crank rings only the bell on that wire, thus saving confusion in the factory. The value of this feature might be illustrated in case of accidents, as a call to the engineer would shut down the engine immediately without question. The magneto call, with the manual switch and factory service call, is manufactured by Keating & Roxburgh, Corry, Pa.

Sprague Road at Cincinnati.

During the last week the Sprague Electric Railway & Motor company of New York has closed a contract with H. L. Littell, president of the Inclined Plane Railway company of Cincinnati, which calls for the entire equipment of the Main street line of that railway, consisting of twenty cars operated over six miles of track. In the equipment of these cars the Sprague improved truck, with improved Boston motor, which has been described in these columns, will be used. The overhead system will be of the neatest and best description. Iron poles of a tasteful design, and set in concrete, will be used throughout the entire length of the road to carry the overhead wires. The regular Sprague working conductor, less than an eighth of an inch in diameter, will be carried over the center of the street, and the main portion of the current will be carried at the side, according to the regular Sprague system. The cars after leaving the city terminus, and running a short distance, come to an inclined plane, where they run upon a platform, and are raised to the top of the inclination, after which the road extends, using the overhead system for the rest of the distance. Both the incline and the cars will be brilliantly lighted by electricity, each car and the power station will be equipped with Sprague lightning arresters, and all the latest and best improvements adopted by the Sprague company upon its roads will be used.

The following experiment is described in the *Archives des Sciences:* In a dark room a platinum cup containing water is placed on a metal support, which is connected with one pole of a Topler machine. Above this cup a metal point is placed, which is connected with the other pole of the machine. A Bunsen burner boils the water in the cup, which is powerfully illuminated by the projection of a large pencil of the electric light. As long as the Topler machine is at rest, the vapor vesicles ascend in the ordinary way; but as soon as the machine is at work, the action of electricity on the vapor is manifested in a most striking manner. For a certain distance from the point to the surface of the water the clouds collect, and whirl along the edge of the cup; under the influence of the electric light they look, to a certain extent, like flames. If the point is brought a little nearer the water the vapor disappears completely, although the water continues to boil briskly.

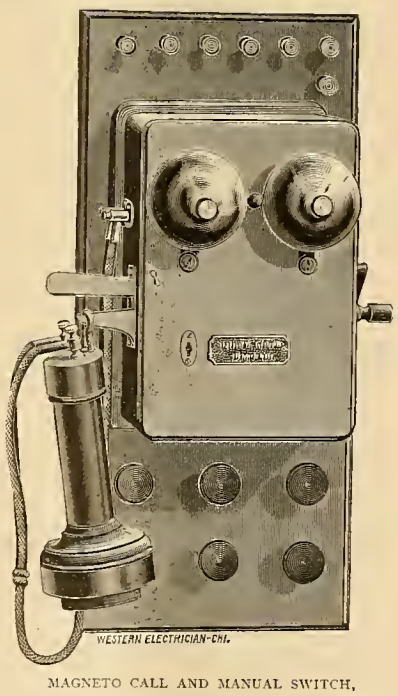
Tests of Pentane Lamp.[1]

By W. Stepney Rawson.

A certain number of lamps were made, and were at first roughly tested. A difficulty arose at first, owing to the leakage in these lamps of the vapor at the spindle, making it difficult to maintain the flame at a constant height. This was, however, completely cured by a drop of glycerine on the spindle, and as there is no action whatever of the pentane upon the glycerine, a small quantity will last a considerable time, and is quite sufficient to withstand the very slight pressure of vapor at that point.

The makers recommend the addition of a drop of glycerine from time to time. The method of testing is the same as that described by Mr. Rawson at a meeting of the Physical section of the British Association in 1886. An incandescent lamp is used as a standard, secondary batteries being employed and a Thomson graded galvanometer checking the constancy of the e. m. f. When the correct e. m. f. has been obtained by means of adjustable theostats the platform of the galvanometer is moved till the needle exactly coincides with a division, and so a minute variation can be easily detected, such as one-twentieth of a degree in 25 or one-five-hundredth part.

A 20 candle power lamp was employed, giving 14.4 candle power. This candle power was chosen because it is such as not to strain the filament in the slightest, and it also gives an illumination on the disc (of the Letheby pattern)



MAGNETO CALL AND MANUAL SWITCH.

very suitable for accurate work, and very similar in color to that of the Pentane flame. In addition to this, calculations are facilitated by the fact that each tenth of an inch on either side of the point (30° from zero) corresponds to .8 per cent. for half an inch on either side. The bar is 144 inches in length and the reachings were made to half divisions upon a metal bar divided into tenths of an inch.

To determine

(i.) The identity of light as long as the flame's height was within the given limits—

The flame was set to the center of the slot and the e. m. f. was adjusted to give a reaching very near to 30 inches. The flame was then altered and readings taken continuously. No appreciable difference could be found while the flame remained within the slot, but the following readings are given as a sample. One observer altered the height of the flame and noted it down while the other took the readings of the disc and called them out:

Inches.	Position of flame.	Average.
30 30.1 30.05	Half way up slot	30.05
30.05 30.05	Two-thirds way up slot ..	30.05
29.9 30 30.1 29.95 30	At top of slot.....	29.99
30.05 30.15 30.1	Half way up slot.....	30.1
30.05 .. Two-thirds way up slot 30.05 .. Quarter way up slot .. 30.05 .. One-third way up slot 30 .. Half way up slot ..		30.04

[1]Abstract of paper in *Gas Engineers' Magazine* Birmingham, England.

The average of the whole readings being 30.04, it will be seen that there is a remarkable steadiness in them, and if we make the usual allowances for personal error we may, on examination of the figures, consider the light practically constant, while the flame is within the slot, there being a slightly less value when the flame is at the top than when it is at the middle or bottom.

To establish—

(ii). The identity of light given by lamps conforming in dimensions with the sample lamp. The following readings were made by comparison with the sample lamp:

Lamp No. 14.....	+ .12	per cent.
" No. 22.....	+ .04	"
" No. 10.....	— .14	"
" No. 24.....	+ .04	"
" No. 12.....	+ .16	"
" No. 7	+ .32	"

Three of the above lamps were compared, with the sample lamp using the 1 candle power gauge and three using the 1.5 candle power gauge. The object of using the latter gauge was to test the identity of the form as well as the light of the flame, and was suggested by the fact that if an error of dimensions caused a variation in the light owing to an alteration of the form of the flame, this variation appeared to be greater in the case of the 1.5 candle power than in the 1 candle power guage. [The error of the .32 per cent. in the last lamp was probably the result of errors of observation.]

To establish—

(iii.) The identity of light of the number 2 standard lamp with the number 1 lamp, and so with the Oxford & Gas Referee's standard, was a point of great importance, and for this Mr. Rawson was assisted by W. F. Donkin of St. George's hospital, who was associated with Mr. Rawson in the comparison of the Pentane and Methven standards, particulars of which were laid before section A of the British association in 1886.

The result of a careful series of tests showed a difference of .5 per cent., the Pentane lamp number 2 being less than the number 1 lamp by that percentage of the value of the latter. In connection with this result it should be noted that in working with the number 1 lamp the exact amount of light given by it depends upon the estimation of the height of the flame, which, by Mr. Harcourt's definition, should be "touching, but not passing," the wire which marks the tip of the flame. It is found that a difference in the estimation of this height exists between various observers, and as a difference of .5 per cent. of the light corresponds to only .2 m.m. in the height of the flame, it is certain that such a difference might well be caused by a difference in the estimate of the height of the flame. In the Pentane standard there is a further check of the rate of flow which is not applicable to the pentane lamp number 1, and the result obtained above is not to be taken as disproving the identity of the pentane lamp number 2 with the Pentane standard. In the present state of photometrical science, we are justified in saying that a divergence of .5 per cent., even if it exists, would not be a serious fault.

To establish—

(iv.) The correctness of the 1.5 candle power and .5 candle power gauges, tests were made with the sample lamp. The mean result with the 1.5 candle power gauge was in excess of .3 per cent. The mean of tests with the .5 candle power gauge showed an excess of 3.75 per cent. The utility of the latter gauge is hardly apparent, and as its use is accompanied with certain slight alterations it has been

abandoned for the time, pending further tests.

To determine—

(v.) The identity of the light given by the lamp under varying conditions of temperature.

The light of the lamp was balanced against that of the incandescent lamp when the temperature of the air was 60° F. Then the glass vessel containing the pentane was immersed in water at 64° F., when the lamp appeared to give a reading .16 per cent. higher than before, but on warming the water to 70° F. the reading found was .04 per cent. lower than at first, showing that the apparent variation was probably due to inaccuracies of observation. The placing of the vessel in water at 70° would naturally produce a greater change than working in air at the same temperature, and we may safely say that change of temperature within working limits produces no variation in the light, as indeed might fairly be anticipated from a consideration of the action of the lamp.

One other question regarding temperature was important to decide, viz.: How far the light of the lamp, varied as it was, warmed to the point at which the height of the flame became perfectly steady; or, if the lamp were over-warmed in the first instance, so that the wick had to be lowered considerably below normal height, in order to produce a flame of the proper height. In order to decide the first of these two points, the lamps were not warmed at all in the usual way, but the vapor was lighted by warming the glass vessel with the hand sufficiently to expand the vapor to the opening of the burner. The flame gradually rose as the lamp became warmer, the wick being about ½ inch from the opening instead of the normal 1½ inches. As soon as the flame appeared above the lower opening of the slot, a reading was taken, which was 3.2 per cent. below the light given at normal temperature. The flame rose quickly, and the wick was turned down so as to keep the place within the slot, and another reading was taken, giving a result 2 per cent. below normal. In 3 minutes after the first reading, the light given was equal to normal, and though the wick had to be considerably further turned down afterward, no change in the light could be detected. We may safely say, therefore, that if no readings are taken till the flame is perfectly steady, no error will be introduced.

In the case of over-warming the lamp, a similar result in the contrary direction was observed, the first reading showing an excess of light of 2.4 per cent., the second an excess of 1.6 per cent., and in about five minutes after the first reading the lamp was giving its normal light. The amount of warming that had taken place is shown by the fact that the flame gradually fell, and the wick was correspondingly raised for about nineteen minutes, during which time no further change could be observed. A convenient test of the right temperature to which the outer cylinder should be warmed previous to putting it in its place, is that which the finger can just bear. We may, therefore, say with certainty, as in the former case, that even if the lamp be over-warmed, no error will be caused if no readings are taken till the flame is fairly steady in height.

To determine—

(vi.) The identity of light given by a lamp burning standard Pentane of different specific gravities.

Three sample qualities of pentane were used, two of which were of the maximum and minimum specific gravities allowed in the manufacture.

These were .632 and .628. The third was of intermediate specific gravity, probably about .63. The results may fairly be considered remarkable and were obtained with considerable care. The mean value of the light was obtained using the pentane of intermediate specific gravity. The vessel was then emptied, and the pentane of greater density was substituted. Thirdly, the pentane of lowest density was used. Taking the first value of the light as normal, the light with the denser pentane was .028 per cent. higher. With the less dense pentane the light was .14 per cent. higher. These values may fairly be taken as identical within the limits of observation. [A similar comparison had been made some years before between the light given by air-gas made with a slightly denser and less dense sample of pentane, with the same result.]

To determine—

(vii.) The difference of light caused by varying the dimensions of the lamp within the narrow limits.

This was a point of great importance, but requiring a very large number of observations if a complete investigation were made. To vary each separate piece that could possibly affect the light, and to note the result, would have been a longer task than could be compassed in the time at disposal, but as in the course of manufacture certain alterations could be made, and the results noted, we will point out the most important. First, as to the existence of what may be called "critical points." One of these is to be found in the position of the top of the burner relatively to the conical piece which unites the larger tube surrounding it with the smaller tube above. It is evident that if the burner projects too high into this conical piece, there will be a checking of the air-draught at the point of combustion, and a diminution of light will take place. The variation in the light was found to be 1¾ per cent. when the top of the burner was 2 m.m. too high. From a consideration of the structure it will be seen that a difference of, say .2 m.m. (an easily measured amount), would produce no appreciable difference. It has been found that if the burner is 2 m.m. too low and a corresponding reduction of 2 m.m. is made in the height of the lower small tube, so as to cause the same portion of the flame to be selected as the luminous source, no difference can be detected in the light. It follows, therefore, that an error of 2 m.m. in the height of the conical piece and tube (which form, as it were, a chimney for the lower portion of the flame) produces no appreciable error in the light. It was found on one occasion that if the portion of the flame selected for the light of 1 candle power was raised 4 m.m. higher, the value of the light was increased by .7 per cent. It was found that the small tube used in the lamps was .5 m.m. smaller in internal diameter than that in the sample lamp, so one lamp had its tubes opened out to exactly the right size, but no difference could be detected. Thinking that perhaps a variation in the size of the apertures admitting air at the bottom of the gallery might affect the light, the arms supporting the gallery of one lamp were considerably reduced in thickness, but the difference in the light was inappreciable.

No doubt any serious contraction of these apertures would have a decided effect upon the light, but an ample margin is allowed in the present construction of the lamp. In the upper chimney not many variations were tested, but 5 m.m. were cut off from the upper part without producing any appreciable difference in the light. Lastly, as to the gauges it was found that a reduction of .15 m.m., or about .9 per cent. in the height of the 1 candle power gauge, produced a difference of 1.8 per cent. in the light, while in the 1.5 candle power gauge the variation of light was in a much smaller ratio to that of height, pointing distinctly to the fact that the upper part of the flame is less luminous than the middle of it.

To determine—

(viii.) The suitability of the lamp for everyday work in photometric tests. It is not easy to establish such a point by a series of tests, but the following were made:

(*a.*) Suppose that the stopper were left out of the glass vessel for some time and air allowed to mingle with the vapor, would any difference in the light be observable? This question was put by an experienced photometrist. Accordingly a lamp was tested with the vessel three-quarters full of pentane. It was then emptied, and the vapor blown out as completely as possible. Then only a small quantity of pentane was thrown in. No change could be detected in the light. Nor could any difference be detected when the pentane was previously well shaken up in an empty bottle, and the resulting mixture of air and pentane vapor poured into the vessel of the lamp with the pentane. In fact, by no method of admixture of air could any error be produced.

(*b.*) Differences due to insufficiency and excess of warming have been alluded to above.

(*c.*) After a very short acquaintance with the lamp an operator would easily light the lamp and be at work within ten minutes, with a certainty of correct results.

(*d.*) The length of time during which the flame will remain absolutely steady under ordinary conditions has been frequently tested with results varying from 17 to 85 minutes, the difference being caused entirely by the variation in the temperature of the surrounding atmosphere. In order to reduce the change of height of flame due to this cause it has been found very advantageous to immerse the glass vessel up to the stopper in a vessel holding about three pints of water. The effect has been found excellent, and the flame has remained perfectly steady for a very long time. Even without this addition, the alteration in the height of flame with a rise or fall of the surrounding temperature is exceedingly slow, and is easily checked by a small movement of the wick.

(*e.*) The re-setting of the chimney with the gauge has been tried many times in succession with perfectly coincident results as regards the light, and by using the obvious method of putting the lamp up to the light to see if any light can be seen between the gauge and tubes between which it rests, the height can be set with ease to a very small fraction of an inch, and identical values of light obtained at every attempt.

(*f.*) The difficulty of leakage has been referred to above, and is very easily prevented by careful fitting and the use of glycerine.

(*g.*) One source of error may be pointed out, but is almost too obvious to require notice. If the lamp is seriously bent, so that the flame is not in the center of the lower tube, or is considerably out of the center of the upper chimney, a loss of light will be the result, but an error of 1 m.m. in the position of the flame in the center of the lower tube has been found to produce no error in the light.

CORRESPONDENCE.

St. Louis, Mo.

ST. LOUIS, Mo., Dec. 8.—The largest and most expensive building in St. Louis is the new custom house, and the custodians are now arranging to discard all other forms of lighting for electricity. There have been for several years four incandescent and two arc light dynamos, but the lights supplied by these were sufficient to light only a small portion of the building, and in consequence gas was used in nearly all the offices and departments. It was determined recently to light the entire building with the incandescent lights, and in consequence the contract for the extra dynamos, the wiring of the building, the changes in the fixtures, and, in fact, for all work, was awarded to the United States Electric Lighting company of New York. In carrying out the contract this company has had dozens of workmen engaged in the building for the past two months, and the work in certain departments is now nearly completed. The dynamos which had formerly been in use have been removed from the sub-basement of the building and shipped to Philadelphia, where they are to be rewound and important improvements added to them before they are returned for use in the new system. The contract calls for the completion of the work by January 15th, and by that time or prior thereto the dynamos will be back in position, and the immense building will be lighted by electricity from cellar to dome. Six dynamos will be the full complement, each of 350 lights capacity of 16 candle power each. These are to be located in the sub-basement, and will be run by two engines of 100 horse power each.

In wiring the building there were used nearly thirty miles of wire of various sizes. This is all pure copper wire, covered with a fire and waterproof coating; this is in turn being covered with a woven linen covering, to prevent the rubber jacket from being worn off by abrasion. At the time the custom house was erected it was not supposed that electricity would take the place of gas for illuminating purposes, and piping only was run through the building. The structure is thoroughly fire-proof, and great difficulty was experienced in drilling through the brick and steel walls to make apertures through which the wires could pass. The walls are, on an average, more than two feet thick, and in doing the work which is now rapidly nearing completion, the walls had to be punctured several hundred times. The wires pass through the holes drilled in the wall, and are hidden from sight under moulding.

Another task which has been a very difficult one, but which is now completed, was the changing of the chande-

liers so as to accommodate the incandescent fixtures. The ones in use in the custom house were very handsome, of solid brass. The gracefully wrought piping to which the burners were affixed have been duplicated and the new ones added to each chandelier, thus giving them a number of electric lights equal to the gas lights now in use without disturbing the old portion of the fixtures.

There are few isolated electric light plants in the country which exceed in the number of lights the one being put in the building. There will be when the plant is completed 2,100 lights in the structure. The ground floor will have 1,000 lights for the use of the postoffice, the basement proper will have 400, and the sub-basement will have 150, the second floor 275, the third floor 250, and the fourth 150, while about 100 will be placed in the dome.

The work of putting in the new dynamos and other appliances, and of wiring the building and the changing of the fixtures has been under the supervision of John P. Bull, assistant custodian, and Col. R. D. Lancaster, collector of the port. The work will be completed about the middle of January, and at that time it is the intention of the officials in charge to give a grand illumination to which cards will be issued.

John Leonberger, John A. Scudder and Mr. Maffitt were in St. Joseph, Mo., last week, examining the electric street railroads in that city. They were all much pleased with the working of the system, and there is a strong probability that it will be adopted on the extension of the Forest Park and Laclede avenue railway and the Market street line. Mr. Maffitt said: "The system of electric motor power used in St. Joseph is the Sprague system, and it is very efficient. The cars are all lighted with electricity, and splendid time is made. It has given perfect satisfaction in every way. If we secure the passage of bills through municipal assembly, giving us the right to put up wires, we will immediately adopt the system on the Tower Grove extension of the Market street line and on the Forest Park extension of the Laclede avenue road In St. Joseph the cars run at the rate of fourteen miles an hour in the outskirts, but they use the regular steam railroad rail. On the rails we have we could not run at such a rate of speed, but I think could make eleven or twelve miles, which would be fast enough. One objection to lighting the cars with the same power used to propel is that when they are running up grade and the full power of the motor is needed, the lights go out; as soon as the top of the grade is reached, however, the car is again lighted. I see no reason why the system should not prove a perfect success here, and if the Missouri and Forest Park companies secure the authorization of the municipal assembly, it will be put in on the extensions. These companies have been desirous of furnishing their patrons with better transportation facilities for some time, but the great objection to putting in a cable has been the number of curves. If the Sprague system should prove efficient on the extensions, and the city council would then grant permission, there is no doubt but the companies would willingly extend its operation to the whole length of both lines." G.

New York Notes.

New York, Dec. 7.—Another trial of the Daft electric motor Benjamin Franklin was made on the night of December 5th on the Ninth avenue elevated road between Fourteenth and Fiftieth street stations. About seventy-five people were present, and were scattered through the four cars which made up the train. The current is brought from a plant located about 1,000 feet from Fourteenth street station, and led along outside the track by a ⅝-inch copper conductor. The motor handled the train in a very satisfactory manner, although it is still somewhat less in power than it should be to haul loaded trains at the speed which is sometimes reached on the elevated roads. It is apparent to everybody, however, that there wss no difficulty in being able to meet the demand, so far as power is concerned. The question of economy and general reliability must, however, be solved before its adoption for general use on the road is likely to be seriously entertained.

Harold P. Brown, electrical engineer, has again made his appearance, this time at the Edison laboratory, where calves and horses were slain by the alternating current on Wednesday, in the presence of T. A. Edison, Prof. R. Ogden Doremus and others. Mr. Brown was assisted by A. E. Kennelly. It was stated that the reason for making these experiments was because the weight of a dog being less than a man the series of experiments at Columbia College last summer was not considered conclusive. This time a calf weighing 124½ pounds was the first victim. Its resistance was 3,200 ohms. An alternating current of 700 volts, applied for thirty seconds, killed it instantly. The second victim weighed forty-five pounds, and had a resistance of 1,300 ohms. The same current for five seconds proved fatal. In order to settle the weight question, a horse weighing 1,230 pounds was killed by the same current His electrical resistance was 11,000 ohms. The doctors, after dissecting the first calf, announced that the flesh was fit for food. Of course vagrant dogs can be obtained for nothing, but veal commands a fair price in the market, and the question naturally arises who is paying for all this, and should the sacred soil of New Jersey be invaded for the sake of showing how criminals may be killed in New York?

At the meeting of the Board of Electrical Control, on Tuesday, a considerable amount of routine business was disposed of. The Western Union Telegraph company was again notified to place its wires in the Broadway conduits within ninety days. The Empire & Bay States Telegraph company, which proposes to use the Delany system between Boston and New York, applied for permission to erect poles and string wires from Woodlawn to Harlem River. The engineer was directed to lay out a route, and the company was advised to use the poles of the Northern N. Y. Lighting company as far as practicable. Charles B. Page, in behalf of the Citizens' Electric Light company, asked for a franchise to do business, and offered to give bonds for $50 000 not to sell out or violate any rules, also to pay 5 per cent. of the gross receipts into the city treasury. The latter was not considered a safe guarantee, and Mr. Page was requested to fill out one of the regular blanks. Superintendent McGrath, in the course of conversation with one of the commissioners, stated that electric lighting had increased 200 per cent. in the city during the past year.

A course of lectures is to be given at the various public schools of this city during the winter, under the auspices of the board of education. One of them will be by Edward H. Boyer on "Electricity as applied to light and power."

The Institution of Civil Engineers has addressed a letter to the American Institute of Electrical Engineers, inquiring how many members of the latter organization are likely to visit Europe next season to attend the Paris Exhibition. The inquiry was made in order that preparation for their entertainment, in company with the members of other American engineering societies, might be provided. Secretary Hutton, of the Mechanical Engineers, has already perfected arrangements by which a special steamer will be placed at the disposal of that society, provided 150 persons engage passage. About seventy-five affirmative responses have already been received. A joint arrangement will be made by the different societies, so that all their members may avail themselves of reduced rates and special accommodations.

The next meeting of the American Institute of Electrical Engineers will be held at the College of the City of New York, Tuesday, December 18th. W. J. Jenks, director of the standardizing bureau of the Edison Electric Light company, will read a paper on "Six Years' Experience with the Edison Meter." The practicability of this meter having been doubted by many prominent electricians, this history of its actual workings will no doubt be a most welcome contribution to electrical science. P.

St. Joseph, Mo.

St. Joseph, Mo., Dec. 8.—Joseph A. Corby left last week for New York City, where he will close up the sale of the Citizens' and Frederick avenue street car lines, and the electric light plant in connection with the roads. This deal has been on for two or three weeks, and it was not known what would be the outcome until yesterday evening. Some time ago a New York syndicate of capitalists secured options on the lines, and yesterday this option expired. The brokers in New York, who were acting for the syndicate, immediately had the option renewed, and telegraphed that they would take the road. It has not yet been given out by the officers of the company what price was received for the lines. On account of the prospect of sale, the Citizens' and Frederick avenue companies have not made the extensive improvements contemplated by them. Mr. Corby, the secretary of the companies, and a large stockholder, in reply to the question as to what improvements would be made by the syndicate, said: "Well, they contemplate many and great improvements. In the first place, they intend equipping all their lines with electricity, and I know that they will build several extensions of their roads. It wont do to say just yet where the lines will be extended to, but it is sure that the syndicate intend spending money in large improvements of this nature. They intend putting in 10,000 incandescent lights, and will then be prepared to furnish power to the different business houses of the city. A piece of ground 30x140 feet in size has been secured at the corner of Third and Mary streets by the syndicate for the purpose of putting up a building to be five stories high and covering the entire lot. The present arc light machinery of the company will be moved to this building, and the cars and lights will be run by power furnished from this building. The syndicate have already let the contracts for the electrical equipments to the Sprague Motor company and the Edison Light company, and the work will be completed as fast as those houses furnish the supplies. This will bring an immense amount of eastern capital to St. Joseph, and the improvements to be made by the syndicate will be a great boom for the city. It is more than probable that the Wyatt Park electric line, which is now about completed, will be secured by this syndicate, but as to that I cannot say anything definite. Other deals will very likely be made before very long." The gentlemen composing the syndicate will contract to furnish incandescent light for residences and business houses, and power to run machinery and elevators in any part of the city. J.

Topeka, Kan.

Topeka, Kan., Dec. 8.—The city electric light department has just completed arrangements whereby oil will be used as fuel. Several months ago the subject of using oil as fuel was brought before the city council, and after due deliberation it was decided to experiment in the electric plant. The oil is transferred to the fire box from a tank through a pipe leading to the burner. The oil is petroleum in its crude state, which passing through the burner is joined with steam, and in the fire box is formed into gas. The burners thoroughly atomize the necessary amount of oil required for proper combustion with the greatest economy. The heat generated with petroleum fire is much more steady than that produced by coal. It is not so sensitive to the fluctuations of the weather, and when once regulated to the proper degree of heat, can be retained at the point without further care or attention. The engine started on the day of the experiment with but sixty pounds of steam, and in a few minutes the steam was run up to 115 pounds. Cold water was run into the boiler and immediately converted into steam, without the slightest fluctuation in the amount of steam.

Economy in labor, cleanliness and safety are secondary considerations. No shoveling of coal or ashes is required, and consequently there is a great saving in labor. There is a complete absence of sparks and cinders. The ability to extinguish the fire instantly, in case of danger, makes it also desirable. There is no smoke whatever. It has been demonstrated that one pound of oil will evaporate more water than three pounds of coal, making the cost equal if not less than coal. The cost of oil is about the same as coal in Topeka, but a great deal is saved on labor and dirt and smoke. F. C. A. Richardson, who represents the American Burner association, said last evening that it would only be a question of a very short time when the hotels, mills and factories of the city would be using oil as fuel.

J. B. Bartholomew, president of the Topeka Rapid Transit company, and Mr. Clark of the Thomson-Houston Electric company, presented a number of plans and the specifications for the electrical equipment of the company's lines at the last meeting of the council. The matter was explained to the council, and referred to the committee on gas and electric lights.

Before proceeding to the regular order of business at the last meeting of the council, Superintendent Riley of the City Electric Light company, was permitted to make a statement to the council, in which he tendered his resignation for the reason that he is a stockholder in the North Topeka Electric Light company, and that company desired him to take entire management of the plant. He expressed his willingness to retain general supervision of the city plant, if desired, at such compensation as might be deemed proper. The matter was referred to a committee.

At the meeting of the city council of Potwin Place, a Topeka suburb, the committee appointed to consult with the Rapid Transit Street Railway company made its report, in which it was stated that the company wished to operate an electric motor line down Willow street and up Woodland avenue to Laurel street. There was much opposition to granting this franchise by the citizens of Potwin. The matter was not passed upon, and was left over for consideration at some future time. H.

Galveston, Tex.

Galveston, Tex., Dec. 4.—The dispatches of last week contained a rumor that Jay Gould had secured the Sante Fe telegraph system. The rumor has been verified. Already linemen are at work in Galveston connecting the Santa Fe lines with the local Western Union office, and the transfer of lines and commercial business is expected to be completed soon. The Sante Fe telegraph system embraces the lines along the railway systems of the two Santa Fes. It is the remnant of what was known as the Baltimore and Ohio system, absorbed by the Western Union some time ago. These lines belong not to the Baltimore and Ohio, but to the Sante Fe, and when the former was purchased the latter reverted to its real owners. A gentleman, well posted in matters pertaining to telegraph service, expresses

the opinion that instead of the new consolidation being a misfortune for Texas it will prove a benefit. He said: "Speaking of competition, you may say that there has really been no such thing in Texas of late. There are but thirty-one common points in the state, and with three or four exceptions they are small places, where the business amounts to little or nothing. While both systems were in operation the Santa Fe was compelled to depend upon the Western Union for service beyond its lines. For instance, if a person at a Santa Fe point desired to send a message to a point reached only by the Western Union, he would pay probably 75 cents, one-third of which would go to the former company, and two-thirds to the latter. Now that the transfer is done away with and direct service secured, he will probably pay but 50 cents. While there may be some equalizing of rates, I think on the whole the public will gain rather than lose by the monopoly. The Santa Fe system was for railway service. They took commercial business when offered but did not seek it. With all railway telegraph lines their own business always takes precedence." E.

Denver, Col.

DENVER, Col., Dec. 6.—Henry Rosener, vice-president of the Postal Telegraph Cable company and the Commercial Cable company passed through this city last week on his way from New York to Southern California. In reply to questions put to him, Mr. Rosener stated that a four-wire line would unquestionably be built across the plains to Denver next season, and that the people would have the advantages of a competitive line before the close of 1889. "We have 4,500 miles of line in this country now, and are extending our service as rapidly as possible," he continued. "Our eastern wires now terminate at Omaha, Lincoln and Kansas City. We have not yet determined from which of the above points we will build, but most probably from Lincoln, along the Burlington & Missouri River railroad. We contemplate putting in two copper and two iron wires. The cost of the line will be $150,000 to $200,000. Regarding our relations with the Western Union company, I can say that there is a tacit understanding between us that we will not engage in a ruinous war, although we are at liberty to make independent rates on local business, and where rates are 25 cents or less we do not cut under them. As you know our company is comparatively young, and while we are steadily branching out, our aim so far has been to cover the leading commercial centers only. We reach nearly all the principal points north of the Ohio river now, except Denver, and are very anxious to get in there. The western service of the Postal Telegraph company is via the Canadian Pacific, following down through California as far as Fresno, and the line is now being extended southward to Los Angeles. The recent enactment of congress defining the obligation of land grant railroad companies will prove quite an advantage to us in extending our lines in the west, and permits us to proceed in our efforts to give all the large western towns a good service, and enable those who desire to use the telegraph for the transaction of business to do so through a service independent of the Western Union. There is no probability of our consolidating with the Western Union. We have made our fight with them, and they have been forced to recognize us as worthy competitors, and I believe would now rather see us in the field than many companies that might have been organized had we not occupied the territory." B.

Kansas City, Mo.

KANSAS CITY, Mo., Dec. 8.—Alderman George W. Lee, president of the council and chairman of the special committee appointed to investigate the telephone rates in this city, received a letter from St. Louis stating that a decision will be rendered December 20th in the trouble between that city and the telephone company there. As soon as that decision is rendered, Alderman Lee's committee will go to work and close up the business for which they were appointed. If the court should decide that the city of St. Louis can regulate the telephone rates within its limits, it is probable that an ordinance will be introduced here fixing, and perhaps lowering, the rates. But in the event of a decision to the effect that cities have no jurisdiction in the matter, the committee will pursue an entirely different course. Alderman Lee thinks that the best way to arrive at the telephone rate trouble is to have the legislature pass a bill enabling municipalities to regulate the rates and tax the telephone companies as they see fit. He says that what would be just in one city may not suit another at all.

Work is being persistently pushed on the new building of the Kansas City Electric Light company for the Edison plant. The roof is now being "put on," the windows "put in," and the boilers "put up." Nearly all of the machinery is on the way, and the company expects to place the machinery as soon as it arrives.

The Missouri & Kansas Telephone company has its new metallic circuit between here and Topeka completed. The distance is 70 miles, and 140 miles of copper wire are strung. The wire is number 12 standard gauge. The circuit works very successfully, and is the largest metallic circuit in the west. The company now has with this new circuit three working circuits between here and Topeka. In this city the company has 10,000 feet of cable strung, and has 11,000 feet more on the way, which will be strung next month. The company now has 2,499 subscribers in this city. C.

THE ELECTRIC LIGHT.

The Cheboygan, Mich., Episcopal church will be lighted with electricity.

It is reported that St. Joseph, Mo, is to have another electric light plant.

An electric light plant is to be installed in the State Industrial school, Rochester, N. Y.

Olympia, Wash. Ter., has decided to contract with the Olympia Electric Light company for street lighting.

The Western Electric Company of Chicago has sold a 30 light arc plant to the McCormick Harvester company.

T. S. Caldwell of Anthony, Kan., has purchased a 35 light arc plant of the Thomson-Houston company of Chicago.

The Thomson-Houston company of Chicago has sold to Oscar W. Ditsch of Kansas City, Mo., a 50 light incandescent plant.

The Emporia Electric & Gaslight company of Emporia, Kan., has bought of the Thomson-Houston company of Chicago a plant of 50 arc light.

The Ashland Electric Light & Power company, of Ashland, Ore., has been incorporated. The incorporators are H. B. Carter, Fordyce Roper, A. C. Helm, L. D. Fielles, and S. B. Galey. The capital stock is $15,000.

The Greencastle Electric Light company of Greencastle, Ind., has sold its entire plant to G. T. Stewart and Charles J. Watts of Springfield, O., who will increase the capacity of the works and otherwise improve the property.

The contract between the city of Natchez and the Thomson-Houston Electric Light company, for the lighting of the streets, has been signed, as well as that between the latter and the Natchez Gaslight company.

There are now two rival electric light systems running at Dallas, Tex. The rivalry has been so fierce that prices are down to a point far below gas, and the gas company has reduced its rates to $1.90, with everybody preferring electricity.

The committee which was appointed at the New York convention of the Electric Light association to report on underground conduits and conductors, met at the secretary's office in New York on Tuesday last. The members of the committee are E. T. Lynch, jr., chairman; Walter C. Kerr, I. H. Davis, H. Crocker, C. H. Barney.

The Brush Electric company of Cleveland has begun an action in the United States Circuit court against the National Carbon company for alleged infringement on patents for improvements in carbon rods or "sticks" for electric lights, and the mechanism for manufacturing them. The court is asked to enjoin the defendants and to award damages.

On December 8th the council of the city of Elgin voted to award the contract to furnish that city an electric light plant to the Jenney Electric company of Indianapolis. It is understood that the price is $18,190, for which the Jenney is to furnish one 100 horse power engine, dynamo capacity for 105 lights, 80 lamps, 8 towers and 15 miles of circuit. Lamps not on towers will be suspended at street intersections.

The new physical laboratory at the University of Michigan has been occupied since October 1st. A 25 horse power Westinghouse engine and a number 2 Edison dynamo are in running order. About fifty 16 candle 60 volt lamps will be lighted in a few days from a Julien storage battery. The installation is now nearly complete. A considerable number of students are now engaged in laboratory work in electricity.

President Baumgardner of the Toledo Electric Light company says that his company is working night and day putting up the new city lighting electric system, and that they will be ready to turn on the lights by the first of January. They have a large force of men employed putting up poles, stringing wires, etc., and are paying out in wages to these men something like $2,400 per week. In view of the rapid development of the city and the continual requests for extension of the service, the Toledo company is putting up additional poles on lower Summit and on Erie street to be prepared for emergencies.

A correspondent of *Industries* at Vienna, writes: "The first transformer installation in Vienna was put up jointly by Ganz & Siemens at the terminus of the Western railway, rather more than a year ago Since then the station has been at work with completely satisfactory results. The dynamos and transformers are of the Zipernowsky type. Having made this good beginning with transformer lighting in Vienna, Ganz & Company are now negotiating with a syndicate of capitalists, the object being to erect a large central station to the south of Vienna, and carry the current right into the heart of the town, in a manner similar to, but on a smaller scale than that proposed for the Deptford installation in London. Whether this proposal is likely to be carried into effect, is difficult to say. The alternate current transformer system is generally liked here, or at least is not regarded with suspicion as regards reliability of the supply; but on the other hand the undertaking is almost too vast to hope that it will be soon carried out."

Among the recent sales of electric light plants of the Thomson-Houston company, Chicago, are the following: Electric Light & Power company, Union City, Ind., 35 arc lights; Tacoma, W. T., Light & Water company, 100 arc lights; Hillsboro, O., Gas company, 70 arc lights; United States military prison, Ft. Leavenworth, Kan., 300 incandescent lights; Electric Light & Power company, San Antonio, Tex., 1,000 lights alternating system; Cornish, Curtis, Green & Co., Fort Atkinson, Wis., 50 arc lights; Thomson-Houston Electric company, Marshalltown, Ia., 30 arc lights.

At the recent meeting of the railway engineers of the Swiss lines, trials were made with an electrically lighted railway coach, which was coupled to one of the ordinary passenger trains running between Zurich and Richtersweil, says a Winterthur correspondent of *Industries*. In addition to the electric light, the carriage was fitted with petroleum lamps and gas, the latter on Pintsch's system, so that the three methods of illumination could be readily compared. The trials were witnessed by about thirty representatives of Swiss railways, and the electric light was unanimously voted the best. The carriage has been fitted up by the Oerlikon Engineering works, which have made the manufacture of storage cells a branch of their general electric lighting business. The carriage consisted of three compartments —one first class, for eight passengers; one second class, for eight passengers; and another second class smoking compartment, for sixteen passengers. The middle of the carriage is occupied by a lavatory. A 10 candle power lamp was fixed in the center of each compartment, and also over the platforms at the ends, in all six lamps, of which four only need be continuously used, since the lamps for the platforms are only required when passengers are mounting or descending from the carriage at the stations. The battery consists of eight cells, having a normal discharge rate of 8 amperes, and a storage capacity of 150 ampere-hours; so that the battery need only be charged after eighteen hours' service. The battery is carried in a wooden box attached to the under side of the carriage, and for convenience of charging the cells are carried in pairs in wooden troughs, which can be quickly inserted or withdrawn. The total weight of the battery is slightly over 3cwt., and the loss of pressure after eighteen hours of service is only 2½ per cent. It has been found that a 6 candle power glow lamp is equivalent to one of the oil lamps at present in use, and that this amount of light is insufficient. With a 10 candle power lamp in the middle of each compartment, and a white reflector, small newspaper print could be quite easily read. The coloring of the upholstery is also an important factor. The light blue cloth of the second class compartments makes the latter appear much better lighted than the Bordeaux red cloth in the first class.

THE ELECTRIC MOTOR.

The electric road in San Jose is running regularly, and seems to have proved a practical success.

It is stated that electric heaters will be placed on the cars of the electric street railway in Richmond, Va

Electric motors of one-tenth of a horse power of the Baxter type are used to run small lathes in the Waltham Watch company's factory.

The directors of the street railway companies in Biddeford and Saco, Me., are considering the advisability of introducing the electric system.

The Brooklyn, South Side and Broadway street railroads of Cleveland, O., have asked of the city council permission to use electricity as a motive power.

American Electric Railroad company, of Chicago, has been incorporated. Capital stock, $1,000,000; incorporators, Hugh Henry, H. Edgell, and Stephen H. Emmens.

It is reported from Richmond, Va., that the Richmond & Seven Pines Railroad company, which has been building a dummy railroad, contemplates ultimately operating their road by electricity.

Prof. Keith has recently put up an electric plant for the Washington Mill company, at Port Hadlock, W. T., consisting of a motor to run a pump to raise 6,000 gallons of water per hour to a height of 130 feet; also, to run 13 arc lights. The electricity is generated a mile from the pumping plant.

It is stated that a syndicate composed of gentlemen residing in Chicago, Cincinnati and Philadelphia, are considering the purchase of the street car system of Quincy, Ill. The new company, if it makes the contemplated purchase, will extend the system, and will make several radical improvements. Electric motors will in all probability be introduced.

The electric railroad at Akron, O., installed upon the Sprague system, has been in operation now for some considerable time, and has been working very successfully, The road has been visited by a large number of delegations of street railway men from all parts of Ohio, Indiana and Illinois. They have carefully investigated the system in operation, the management affording them every opportunity for so doing, and the universal verdict has been, that the Sprague system is all that is claimed for it.

By slow degrees, but apparently with great certainty, electricity is making advances toward the time when it shall altogether supersede horses as the motive power on street railroads, says the *Mechanical News*. A large number of such roads in different parts of the country are using electric power, either with overhead conductors or with conduits beneath the cars, constantly depending, of course, for their supply of energy on the central station where it is generated. A still more interesting form of the experi-

ment is that in which storage batteries are used. * * * It is also a noteworthy circumstance that the management of the elevated roads are adopting a favorable attitude toward electricity as a motive power. They are reported to have asked the same company, whose motors are used on the Fourth avenue surface road, to make estimates for the equipment of the grand central branch of the Third avenue elevated with electric motors.

Rochester, N. Y., capitalists interested in the proposed electrical suburban railway are meeting with considerable opposition from the R., W. & O. Railroad company, with which it will compete. The electric railway company has been granted the right of way over the entire route, excepting on the R., W. & O. bridge, and it is expected that a commission will be appointed at an early day and condemnation proceedings begun.

The Thomson-Houston Company of Chicago, Theo. P. Bailey, manager of the railway department, has taken a contract for making a three-mile extension to the Wichita, Kan., electric railway, In giving the order the company says: "This, in itself, should demonstrate pretty clearly to you that we are well satisfied with the line as it runs at present. As long as we can get efficient service as we are now getting, we shall consider the system eminently successful. We are well pleased with its action now."

The directors of the Silvey Electric company, of Lima, O., have decided to add the building and construction of electric railways to their business. They have determined after extended experiments and trials to take this step, feeling that they have the system and material to compete successfully with any electric railroad now in service. The large generator built for the electric railroad in Lima is now in successful operation at the electric light station. It has current for 100 horse power, and works satisfactorily. They have just completed a new street car motor, which has proved extremely efficient.

The electric railway which is now being installed at Cleveland by the Sprague Electric Railway & Motor company of New York is being pushed forward as rapidly as possible, and Dr. Everett, president of the road, expects to have all the cars running about the middle of December. The electrical equipment of this road will consist of sixteen electric cars, which will run over ten miles of track. The power house on Cedar avenue has been completed, and the four dynamos for generating the necessary electricity are in place, and ready for work. On Euclid avenue the overhead system is nearly completed, and the rails are being riveted together and electrically connected for the return circuit. Great care has been taken with the overhead system in order to render it neat and pleasing to the eye, and although the poles are of wood they are very carefully set, and their appearance does not strike even the most critical observer as at all unsightly. An eighth of an inch conductor is used, and the entire overhead system of poles and cross-wires is correspondingly light and small. Another great advantage of using a small working conductor over the center of the track, supplemented by the main conductor at the side, is that no increase of the size of working conductor is required with an increase in the number of cars run, or an addition to the length of the line.

THE TELEPHONE.

The work of setting telephone poles between Trinidad and Sopris, Col., is progressing rapidly. Mr. Farrell reports the line of poles nearly completed.

The long distance telephone can hardly be called one of the wonders of the century, says a New York paper. Our cautious grandparents would turn in their graves did they hear their own century associated with such an instrument Rather must we call it one of the wonders of the day. Even in its most primitive form the telephone is only a thing of yesterday, and its extension to long distance communication may with equal truth be said to be only a thing of an hour ago. Bankers, brokers and the hundreds of all classes who daily make use of its wondrous secret will hardly realize that it is yet less than a year since the first ten wires were put in operation between New York and Boston by the American company. The subsequent increase in wires in this connection alone attests the increased demand for such means of intercourse, and it is the best possible guarantee of the entire satisfactoriness of the system. The first ten wires were put in operation on the 1st of January of this year; other ten were added in April, ten more in July, and still other ten were put in operation about thirty days ago. Such is the increased demand for the lines that the company expect within a year to have in operation a duplicate route with thirty wires But the extension has not been merely in one direction. All the leading cities of New York, Pennsylvania, New Jersey, Connecticut, Massachusetts and Rhode Island are now bound together by a tie that knows no distance. Within a half hour one can carry on conversations with parties in Boston, Buffalo, Troy, Hudson City and Philadelphia, and transact an amount of business which, if done by traveling, would occupy at the least, three days. By another year the company expects to have Chicago tied in the brazen knot, and if this is accomplished it is surely not too much to expect that by still another year some of our good citizens may be rung up for a few minutes' conversation with a friend in London. Much of the increase in the business of the long distance branch of the company is traceable to the fact that many business houses who have formerly owned private ones are gradually drifting into the company's service, finding it less troublesome, more reliable and less expensive. The most singular characteristic of this remarkable space annihilator is that the long 'phone does its work infinitely better than the short distance 'phone. The cork-pulling sensation, which usually follows "Hello, Central," is noticeable by its absence. Nothing is heard but the voice of the speakers, and the voices of the speakers are heard. One can carry on a long conversation with a Boston friend and not have to ask for a repetition, and the not uncommon experience in the short-distance 'phone of commencing a sentence to the person and finding at its close that a different individual is listening, is rendered wholly impossible. The long distance 'phone is daily used for the transmission of lengthy messages largely consisting of figures, of long press messages and of others which are largely impossible on the short distance 'phone.

THE TELEGRAPH.

The Railway Telegraphers of Chicago gave their annual reception December 6th.

A dispatch from Ottawa, Ont., says: It is understood that a company is being formed, with a capital of $2,000,000, to undertake the laying of a telegraph cable from Blanc Sablon, at the straits of Belle Isle, to a point on the coast of Scotland or Ireland. Government aid will probably be given.

Miscellaneous Notes.

It is said that the authorities of Toledo propose to take steps to decrease the number of overhead lines in that city.

Two valuable horses were killed last week by an electric street wire dropping on them, at Wilkesbarre, Pa. The driver was rendered unconscious.

W. R. Kimball lectured recently before the Y. M. C. A. of Montreal on dynamo-electric machinery. The lecture was illustrated by many stereopticon views.

The first reception of the Western Electric Benevolent association of Chicago was held Thursday evening, December 6th, at Brand's hall, and was a thoroughly enjoyable affair, as well as a financial success. The committee in charge, to whom the success of the affair was largely due, were composed of the following named gentlemen: Arrangements, Charles Varela, G. Gehrke, N. Fricker, R. Horn, E. Hazen; floor, H. Hazen, F. J. Pelton, M. Cannon, O. Nicolas, D. J. Rowe, W. Haeger; reception, G. Gehrke, W. E. White, F. L. Wise, Howard Bowen, M. Lund, Al Tinker.

The National Subway company, which is laying the underground conduits in Minneapolis, is extending its lines with commendable rapidity, even if the prospects of immediate returns are not flattering, says a Minneapolis paper. The excavations have been extended down Washington avenue to the Milwaukee depot, and Mr. Dorsett's perforated cylinders are going down steadily in the new trenches. By the terms of the ordinance, three miles of the Dorsett conduits were to be laid and ready for service by December 1st. The company is evidently anxious to carry out its agreement to the letter. The National company intended to lay its conduits so as to accommodate the various corporations using electric wires, but the council failed to grant an exclusive franchise, and other companies are applying for a division of the benefits. Thus far no agreement has been made with any other company, except, possibly, the Brush. The city is granted the use of the conduits for its police and fire alarm wires, free of rent. The Dorsett people are going forward with their work and waiting for customers like common carriers, hoping to rent space to future applicants. The Western Union company is operating its own conduits in eastern cities, and intends to do so here. The telephone company has asked permission to lay conduits independent of the Dorsett system, but declines to furnish any guaranty in regard to the date of completion, while the Edison Electric Light & Power company is ready to excavate for its wires at once, but is debarred by the franchise granted to the National Subway people. According to present indications Minneapolis will be compelled to surrender a considerable portion of its streets to different conduit companies. If the Dorsett company fails to lease its holes to other corporations, as originally intended, it is not easy to see how it is going to get even on its investment. As the case now stands not a single wire is going into the Dorsett conduits except the city wires, for which no rent is paid.

Personal Paragraphs.

Frank B. Rae has become connected with the motor department of the Detroit electrical works

F. B. Trout, general manager of the Woodward Electrical company, Detroit, and Capt. C. H. Thomson, director and electrician of the same company, were in Chicago last week.

T. S. Miller, who has been connected with the Link Belt Machinery company, Chicago, for over six years, has accepted a position with the Lidgerwood Manufacturing company, New York. Mr. Miller was a member of the Chicago Electric club.

Business Mention.

The Phoenix Glass company, of New York and Pittsburgh, is doing a very large business in arc and incandescent globes. The company recently received an order for 100 dozen globes from Tokio, Japan.

The Woodbury Engine company of Rochester, N. Y., has just issued a neat pamphlet devoted to a description of its new automatic self-contained high-speed engine. This engine is one of the most economical and most closely-regulating of any in the market, and its performance is thoroughly satisfactory in every case.

The Knapp Electrical works have purchased the entire plant, good will and business of the Railway Telegraph Supply company. The business will be continued in the four-story building occupied by the latter company at 54 and 56 Franklin street, Chicago. For the Knapp Electrical works success from the beginning can be predicted. With plenty of capital and increased facilities in every department, the business will be carried on in the pushing and energetic manner characteristic of the company's general manager, Myron A. Knapp. The old patrons of the Railway Telegraph Supply company can rest assured that their wants will be conscientiously looked after by the new concern, and they will have the advantage of a much heavier stock of goods to select from than before. The Knapp Electrical works are equipped to do a large manufacturing and selling business.

The electrical railway in operation at Wilmington, Del., installed by the Sprague company, has been working very successfully, and the management of the road have written to the Sprague Electric Railway & Motor company of New York, expressing their satisfaction, and giving orders for an additional number of cars.

The Woodward Electrical company of Detroit finds the field for the storage battery constantly broadening, and its applications multiplying. The Detroit storage battery is an excellent production, being free, according to Captain Thomson, electrician of the company, from the trouble of buckling and the other numerous disadvantages heretofore peculiar to accumulators. The company has lately installed a plant for Prof. Elisha Gray in his laboratory at Highland Park, they have a plant in operation at Petoskey, Mich., another at Battle Creek, Mich., and other places. The Michigan Central Railroad company is equipped throughout with the batteries for signal purposes. The company is just getting into a new factory, and have a large amount of work ahead. In Chicago a plant has just been installed at the Western Electric company's factory, and in Detroit Gen. Russell A. Alger's residence is being equipped with batteries for 250 incandescent lights.

Since November 26th the Western Electric company of Chicago has sold electric light plants as follows: Marshall Field & Co., Chicago, 25 light arc dynamo; Wheeler & Tappan, Chicago, 12 light arc dynamo; Haxtun Steam Heater company, Kewanee, Ill., 25 light arc dynamo; McCormick Harvesting Machine company, Chicago, 35 light arc dynamo; Chillicothe Water, Gas & Electric Light company, Chillicothe, Mo., 35 light arc dynamo; The Consolidated Ice Machine company, Chicago, 12 light arc dynamo; J. Curran, Chicago, 45 light arc dynamo; Barnard & Leas Manufacturing company, Moline, Ill., 35 light arc dynamo. The company has also done the wiring for incandescent lighting for many buildings and residences. Among the latter are Conrad Seipps' and Thomas Murdock's new homes. As the company has a large number of plants under way which must be completed within a few weeks, including the Chicago city plant, it will be seen that the electric light department is kept extremely busy. A force is kept busy day and night engaged in constructing electric light apparatus. The company has also received the contracts for wiring Owing's 14 story building, corner Dearborn and Adams streets, Chicago.

Electrical Patents.

Issued December 4, 1888.

393,741. Voltaic Plaster. Willard C. Collins, Bucksport, Me.

393,742. Dynamo Electric Machinery. W. Forman Collins, New York, N. Y

393,744. Indicator for Secondary Batteries. Stanley C. C. Currie, Philadelphia, Pa

The invention consists in utilizing the ebullition of the fluid contents of the battery to establish an electric circuit through an electrically operated visual or audible signal, thereby indicating that the battery is charged.

393,745. Armature for Dynamo Electric Machines. Leo Daft, Plainfield, N. J.

393,749. Trolley. Frank E Fisher, Detroit, Mich.

393,755. Mode of making Secondary Battery Plates. William W. Griscom, Haverford College, Pa.

393,756. System of Electric Lighting. William W. Griscom, Haverford College, Pa.

393,757. Train Lighting by Secondary Batteries. William W. Griscom, Haverford College, Pa

The last claim is given: "In a train circuit having three conductors, the combination of a pair of circuit connectors, each having three contact points located in the same line or plane."

393,814. Galvanic Battery Peter C. Burns, St. Louis, Mo.

The cup is formed with a flange extending part way around its upper edge to support the cup and to close the mouth of the jar. The zinc is supported in the jar so as to prevent contact between it and the carbon cup.

393,823 Submarine and Subterranean Electric Cable Elias Flotron and Francois B. A. Royer de la Bastie, Paris, France.

The chief feature of novelty consists in the employment of short rings of toughened glass for separating and insulating the wires as well as for the external sheathing.

393,824. Telephone Exchange Switch Fastener. William M. Goodridge, Chicago, Ill.

A clamp is provided for fastening the strips to the switch-board, which may be clamped or unclamped from the front of the board to hold or release the strips which are inserted at the rear of the switch board.

The first claim is given: "The combination, with the stile or frame of the switch board, of strips of spring jack switches mounted thereon from the rear and a clamp inserted from the rear and held in place by a nut, the head of said bolt being in the form of a button, whereby the strips may be held in place or removed on turning the bolt."

393 828 Electrical Water Elevator for Buildings. Albert E. Hall, Plainfield, N. J.

393,849. Dynamo Electric Machinery. Samuel E. Nutting, Chicago. Ill.

The third claim reads: 'In a dynamo electric machine, the combination of upper and lower pole pieces and two pairs of field magnet coils interposed between the pole pieces near their four corners with their ends inclosed in sockets in the pole pieces."

393,865. Semaphore Signal Frederick Stitzel and Charles Weinedel, Louisville, Ky.

The invention is intended to further perfect the working mechanism of a semaphore signaling device so as to render each block a continuous magnetic circuit when it is clear of cars or in a state of "safety" and cause the locomotive or cars that enter the block, and while they occupy the same, to cut off the battery current from the electro-magnet of the semaphore and return it to the battery by establishing a continuous circuit through the wheels and axles of the locomotive or cars.

The tenth of the twelve claims is given: "In a semaphore signaling device, the combination, with a horizontal shaft pivoted to rock on its centers, of a thermo motor and a quadrant secured on and to this shaft to rock with it, and a rocking arm loosely mounted on the shaft that gives support to the motor and quadrant."

393,954. Method of Producing Electrodes for Secondary Batteries. Henry Woodward, Shepherd's Bush, County of Middlesex, England.

The fourth claim is appended: "The method of producing a support for an electrode by casting a metal, such as lead, upon a body of rock salt contained in a mold having a transverse and substantially central ridge, removing the body after cooling, dissolving out the rock salt, and placing the parts on each side of the depression, together with the smooth portions, inward."

393,955. Electrode for Secondary Batteries. Henry Woodward, Shepherd's Bush, County of Middlesex, England.

The second claim reads as follows: "A body suitable for an electrode for a secondary electric battery, consisting of a metallic or plastic mass having an irregular cellular surface and a solid backing or interior integral therewith."

393,998. Electric Bell. James F. McLaughlin, Philadelphia, Pa.

394,015. Motor for Street Cars. Wilber S Salisbury, Chicago, Ill.

The last claim is: "In a motor for street cars, the combination, with the axle and a gear wheel mounted thereon provided with elongated peripherally grooved hubs, of a casing constituting a support for electric motors operating said gear wheel, anti-friction rollers bearing in said grooves, and removable sectional bushings interposed between said rollers and the bearing-walls of said casing."

394,035. Electric Motor. Charles J. Van Depoele, Chicago, Ill.

The object is to assemble and combine the several co-operating parts of a complete electro-dynamic motor or engine in a single structure.

Claim 4 is: "In an electro-dynamic motor, a field magnet provided with main and auxiliary coils, said coils being wound and connected in two separate portions arranged in multiple relation to each other, connections extending from said multiple arc coils to part of the terminals of a switch, and a series of resistances connected to other terminals of said switch, and arranged to be thereby connected in series with the coils of the field magnet."

394,036. Duplex Electromotor. Charles J. Van Depoele, Chicago, Ill.

The fourth claim reads: "The combination of a plurality of armatures, a field magnet common to both armatures, a series of resistance coils, and a switch lever arranged to connect more or fewer of the resistances in series with the coils of the field magnet."

394,037 Constant Upward Pressure Contact for Overhead Conductors. Charles J. Van Depoele, Lynn, Mass.

The invention comprises, chiefly, a contact carrying arm of novel design and means for maintaining an upward contact of constant pressure between the contact device at the extremity thereof, and the undulating under side of the suspended conductor.

The last claim reads: "A contact arm mounted upon a hinged support and having a portion of its length rigid or semi rigid, and a flexible whip-like end, to which the contact trolley is secured."

394,038. Duplex Upward Pressure Contact. Charles J. Van Depoele, Lynn, Mass.

The invention has reference to a duplex form of contact device for maintaining contact with both conductors when both positive and negative line conductors are suspended above the track in contradistinction to the system employing but a single overhead conductor for each track.

The last claim follows: "The combination, with an upward pressure contact arm, of contact-carrying fingers mounted upon said arm and provided with means for separately pressing said fingers against the conductors, and stops for limiting the upward movement of the fingers."

394,039. System of Suspending Electric Conductors. Charles J. Van Depoele, Lynn, Mass.

Claims 5 and 16 are: "In a system of suspended electric conductors, the combination with main and branch conductors at a turn out, of suitable frogs or switches near its extremities, supporting poles at or near said extremities, cables extending between the poles, along the turn-out in the direction of the line of way, and transverse conductor-supporting wires connected to said cables.

"In a system of suspended electric conductors, the combination, with a supporting wire and an ear or bail to which said wire is to be attached, of a collar or sleeve encircling and uniting the main and return bend of said wire."

394,049. Workman's Electric Time Recorder. William K. Bassford and Edwin B. Maynard, New York, N. Y.

394,062. Apparatus for Removing Scale from Electric Conductors. Leo Daft, Plainfield, N. J

The first claim is:- "The combination, with an electric locomotive, of an emery wheel carried by the locomotive and moving on the rail to grind and polish the same, whereby rust and scale are removed, and the metallic surface is maintained and continually exposed."

394,075. Electric Motor and Dynamo Electric Machine. Orazio Lugo, New York, N. Y.

394,081. Electric Annunciator Target. Francis J. Patten and Theodore A. Bingham, U. S. Army.

Claim 5 reads as follows: "An electric annunciator target composed of sectional metallic plates and having attached to each plate a key or circuit-breaker connected each to a different combination of wires or electric circuits from that of any other section or plate."

394,090. Thermopile. Henry Woodward, Detroit, Mich.

The fourth claim is given. A thermo-generator consisting of the flue, the concentric passages leading one into the other, the outer casing provided with openings, and the elements extending through the openings to be brought in contact with the heat."

394,095. Commutator. Charles L. Buckingham, New York, N. Y.

The second claim is: "As a means of preventing flashing, the combination of a commutator and brushes and an oil reservoir holding only sufficient oil to cover the points of contact between the brushes and commutators."

394,100. Indicator for Secondary Batteries. Stanley C. C. Currie, Philadelphia, Pa.

394,139. Sectional Double-Line Electric Railway. Sidney H. Short, Columbus, Ohio.

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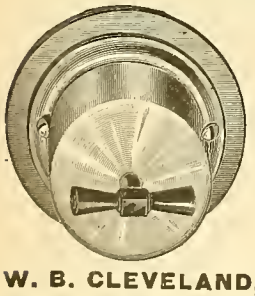

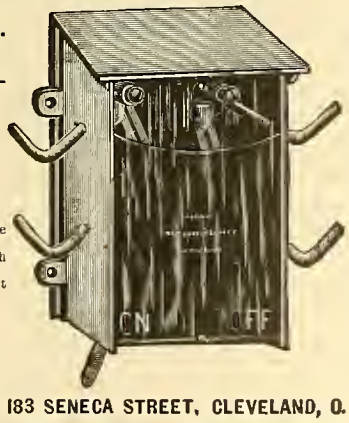

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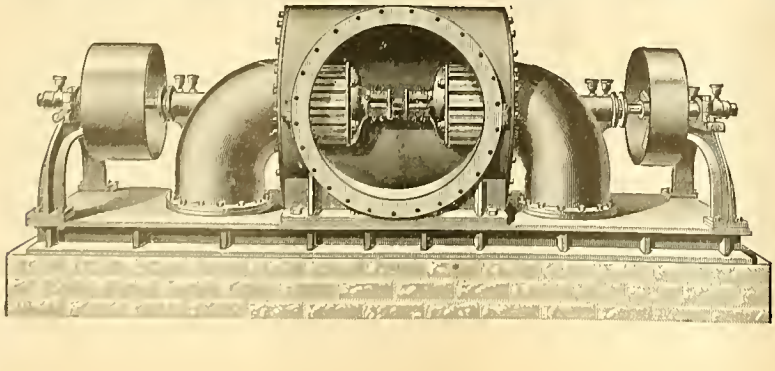

The attention of ELECTRIC COMPANIES is called to this CELEBRATED WATER WHEEL as particularly adapted to their use, on account of its remarkably steady motion, high Speed and great Efficiency, and large Capacity, for its diameter, being double the Power of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an an equal, producing the highest per cent. of useful effect guaranteed.

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch VICTOR TURBINES arranged on a horizontal shaft, with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

STANDARD ELECTRICAL TEST INSTRUMENTS,

Ammeters and Voltmeters of all kinds.

AYRTON & PERRY NEW SPRING.

CARPENTIER, HABTMANN & CO.,

Galvanometers, Bridges and Rheostats by all the Prominent Makers.

CALL AND EXAMINE.

James W. Queen & Co.

924 Chestnut St., Philadelphia.

WANTED--CHANCE TO INVEST.

Parties of large experience and established reputation in the Electric Lighting business desire to invest $25,000 in manufacturing first-class Electric Light Machinery.

Address ELECTRIC LIGHT CO.,

CARE WESTERN ELECTRICIAN.

A. A. McCreary's Reflector Shade

(PATENTED.)

BEAUTIFUL AND DURABLE.
COMFORTABLE TO THE EYES.
NO DIRECT RAYS.
LAMPS INCREASED MORE THAN DOUBLE IN ILLUMINATING POWER.
5 SIZES for 10 to 100 C. P. Lamps.
SUSPENDED BY FLEXIBLE CORD.
NO FIXTURES REQUIRED.

18 and 20 Cortlandt Street, NEW YORK.

Send for Circular B.

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Messrs. AHEARN & SOPER, - OTTAWA, ONTARIO.

G. A. HARTER, Manager. 175 Randolph St. CHICAGO.

The Electrical Construction Co.

CONTRACTS TAKEN FOR THE ERECTION OF

Electric Light Plants Complete.

"If you have any Lamp Spools to re-wind, send them to us, and we will do it for a reasonable price."

All Classes of HOUSE WORK a Specialty.

THE LINK BELT MACHINERY CO.

11-23 South Jefferson Street, CHICAGO.

MINNEAPOLIS. NEW YORK.

BURR & DODGE, 125 N. 5th St., Philadelphia.

Friction Clutch Pulleys

FOR DYNAMO DRIVING.

Investigate Before Buying.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union,** under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof,* and *will not deteriorate, oxidize* or *crack,* and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,
61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

OKONITE

TRADE MARK.

INSULATED WIRES AND CABLES,

Electric Light, Telephone and Telegraph,

Manufactured for **AERIAL, SUBMARINE** and **UNDERGROUND USE.** **OKONITE TAPE** for making waterproof joints.

Sole Manufacturers CANDEE AERIAL WIRES. THE OKONITE CO., 13 Park Row, New York.

BRANCHES:—Chicago, 42 LaSalle St., Boston, Philadelphia, Omaha, Minneapolis, Cincinnati, Louisville, Kansas City.

DETROIT ELECTRICAL WORKS,

MANUFACTURERS OF

Electric Supplies

INCLUDING

Medical Batteries, Skeleton, Iron and Box Bells, Burglar Alarms, Hotel and House Annunciators, Fire Alarm Boxes, Pins and Brackets, Insulated, Magnet, Telephone and Electric Light Wire.

BUILDERS OF

Fisher's Electric Motors,

AND ALL APPLIANCES FOR CITY AND SUBURBAN

ELECTRIC RAILWAYS.

General Offices and Works, - - DETROIT, MICHIGAN.

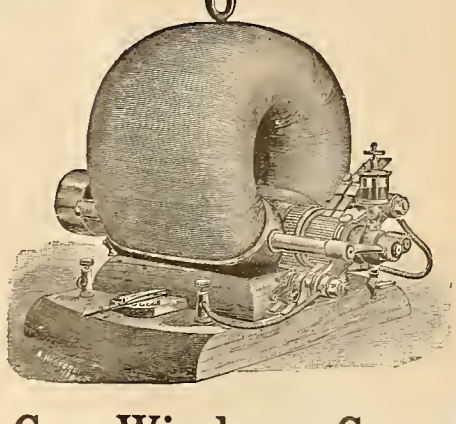
THE EDDY ELECTRIC MFG. CO.

MANUFACTURERS OF

Automatic Electric Motors,

IN ALL SIZES FROM ONE-HALF H. P. UPWARDS.

High Efficiency, Perfect Regulation, Superior Workmanship, Ease of Management, Remarkable Simplicity, Etc., Etc.



Dynamo Electric Machines,

FOR ELECTROPLATING, ELECTROTYPING, COPPER REFINING, ETC.

C. F. DUNDERDALE, Agent,
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The Eddy Electric Mfg. Co., Windsor, Conn.

WE PATENT AND EXPLOIT

In Foreign Countries first-class Electrical Inventions which are new and operative, and have been illustrated by models and drawings, but not published in this country before being patented abroad. No expense to the inventor; call or write.

FOREIGN PATENT EXPLOITING CO.,

1007 Opera House Block, CHICAGO, ILL.

FRANCIS W. PARKER, Solicitor.

FRANCIS W. PARKER,

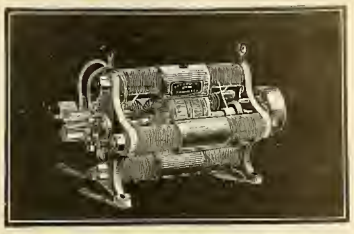
SOLICITOR of ELECTRICAL PATENTS

THE ONLY COMPLETE SET OF U. S. ELECTRICAL PATENTS IN CHICAGO.

1001-3-5-7 Opera House Block, CHICAGO.

I. W. COLBURN & CO.

No. 174 Main St., Fitchburg, Mass.



Machines for Arc and Incandescen Electric Lighting, Electru-Plating and Experimental Use.

Send for large Illustrated Catalogue, also Handbook of Ready Reference, vest-pocket edition.

THE B. F. GOODRICH CO., AKRON RUBBER WORKS, AKRON, O.

—MANUFACTURERS OF—

Hard Rubber Goods for Electrical Purposes.

SPECIALTIES OF ALL KINDS MADE TO ORDER.

Soft Rubber Tubing and Rubber Tape.

Catalogue and Prices furnished on application.

AGENTS WANTED EVERYWHERE.

FOR ANYTHING

In the Line of Temperature Regulation,

Either Furnaces or Steam Heaters

In Houses, or for Special Apparatus, address

The Guion Antomatic Heat Regulating Co., ELMIRA, N.Y.

DO YOUR OWN ELECTRIC LIGHTING

IF 25 LIGHTS OR LESS WILL DO IT

HOW? SEND STAMP FOR CIRCULAR WHICH WILL TELL YOU.

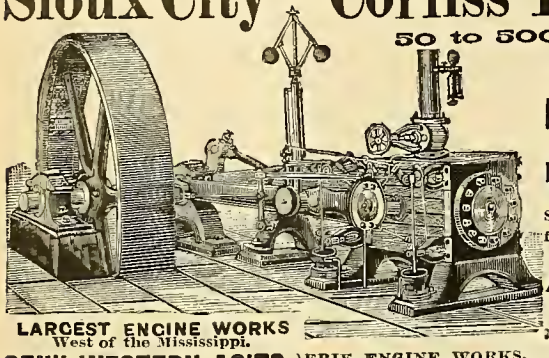
PUT AN ELECTRIC BELL IN YOUR **HOUSE OR SHOP**

CAN DO IT YOURSELF WITH OUR $2.50 OUTFIT

C. E. JONES & BRO. CINCINNATI O.

Sioux City Corliss Engine

50 to 500 H. P.



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Sioux City ENGINE WORKS

Sioux City, Iowa.

BOILERS

—AND—

Steam Power Outfits for Lighting Stations and Elevators

A SPECIALTY.

Send for Circular F.

State Business.

LARGEST ENGINE WORKS West of the Mississippi.

GEN'L WESTERN AG'TS. ERIE ENGINE WORKS. SHIPMAN OIL ENGINE. MILLER DUPLEX STEAM PUMP. CIRCULARS FREE.

ARC LIGHT GLOBES. INCANDESCENT SHADES.

Write for NEW PRICES Before Buying Elsewhere. Large Stock on Hand to Fit Different Systems.

Southwestern Electrical Supply Co. KANSAS CITY, MO.

ELECTRICAL GOODS OF EVERY DESCRIPTION.

The H. M. LOUD & SONS LUMBER CO.

MANUFACTURERS OF

Telegraph and Telephone Cross Arms, Cedar Poles, Posts and Ties. Large Supply of Dry Cross Arms Lumber kept in stock. Orders Filled Promptly.

Office and Mill at Oscoda, Mich.

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Chicago Electric Club.

There will be a meeting of the *Chicago Electric Club* Monday evening, December 17th at 8 o'clock, at the rooms of the Club, 122–124 Clark street.

SYNOVIAL Dynamo and Cylinder Oils.

Second to none. Free from gum or acids. Especially adapted for all fast runnning machinery. By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

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THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

CARBON PLATES,

FOR ELECTRICAL PURPOSES.

NEW YORK CARBON WORKS,

Send for Price-List. 18 Cortlandt St., Telephone Building, N. Y.

WILLIAM A. DOTY,

MANUFACTURER OF ELECTRICAL SUPPLIES.

GAS LIGHTING KEYS A SPECIALTY.

Agent for the LAW BATTERY.

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THE EDISON MACHINE WORKS,

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—MANUFACTURERS OF—

Insulated Wires, Flexible Cords and Cables for Telephone, Telegraph

—AND—

ELECTRIC LIGHT.

JAMES F. KELLY, General Sales Agent, 19 Dey Street, New York.

Bell Hangers' Hand-Book,

BADT, $1.00.

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ELEMENTS of ELECTRIC LIGHTING,

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All three Books, to one address, cash with order, $3.00.

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WANTED.

AGENTS for Lord's Boiler Compound. A chance for Engineers and men on the road. Also local Agents with means. State present occupation. Address,

GEO. W. LORD,

316 Union Street, Philadelphia, Pa.

Russell & Co.

MASSILLON, OHIO,

BUILDERS OF

AUTOMATIC ENGINES

BOILERS, ETC.

Complete Power Plants Furnished and Erected.

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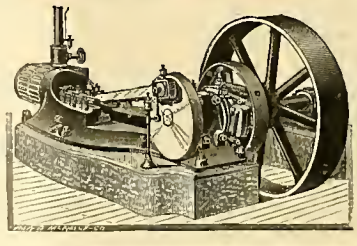

GEO. H. BLISS,

ELECTRICAL EXPERT

DEALER IN Electrical Securities. | EXPLOITER OF Electrical Inventions.

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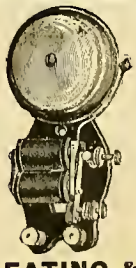


Of dealers and others is called to this bell, the advantages of which can readily be seen in its adjustment for regulating the spring which supports the Armature. By simply turning a screw the spring is made to conform to the strength of battery current, one cup of battery will work it louder and stronger than will two or three others of different make.

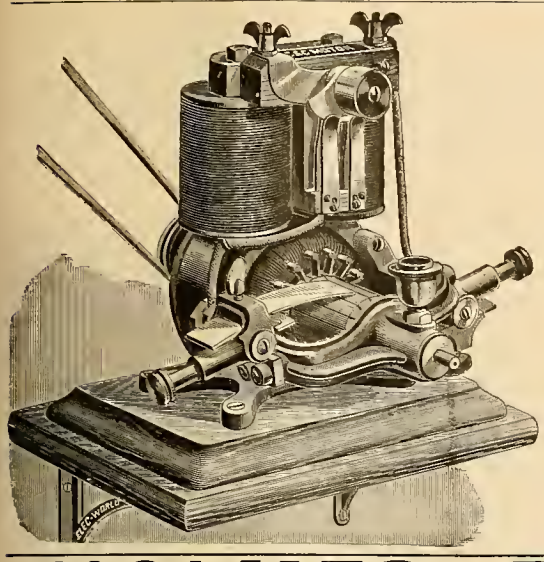
We can supply it in either bracket or box form; it is nicely nickeled and put up in the best of workmanlike manner. Prices furnished on application.

KEATING & ROXBURGH,

—MANUFACTURERS OF—

Sounders, Keys, Bells, Batteries, etc., dealers in all kinds Electrical Supplies.

CORRY, PA.



"C. & C." ELECTRIC MOTOR CO.

90 South Fifth Ave., NEW YORK.

EFFICIENT ELECTRIC MOTORS

MANUFACTURED FOR ARC AND INCANDESCENT CIRCUITS.

AUTOMATICALLY REGULATED.

NEW ENGLAND OFFICE: 19 Pearl St., BOSTON.
WESTERN OFFICE: 139 and 141 Adams Street, CHICAGO.
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HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT "K.K." LINE WIRE TRADE MARK "K.K."

FOR ELECTRIC LIGHT, TELEGRAPH AND TELEPHONE LINES.

FACTORIES: WATERBURY, CONN.

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THOS. L. SCOVILL, NEW YORK AGENT.

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SUNLIGHT CARBONS

The Parker-Russell Mining & Mfg. Co.

ELECTRIC LIGHT CARBONS

—CITY OFFICE—

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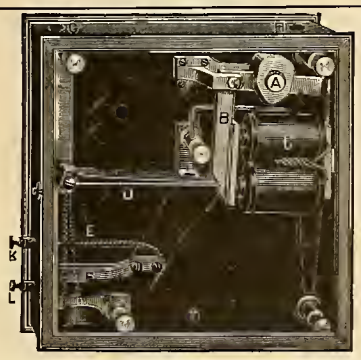


Protect your Armatures

It is a matter of everyday experience among Electric Light men that Armatures are frequently burned out entirely, or seriously injured by the short circuiting of machines. This entails delay, trouble and expense.

Wright's Armature Protector Absolutely Protects

Armatures from injury resulting from the short circuiting of machines. No machine can burn out if protected by Wright's Armature Protector. One of the most valuable inventions of recent years.

"Adapted to any System"

Now on the market. For information and prices, address

CHAS. D. WRIGHT, Petersburg, Ill.,
or ELECTRICAL SUPPLY CO.,
171 Randolph Street, Chicago.

See letter of recommendation from electrician Chicago Arc Light & Power Co., on advertising page xiii WESTERN ELECTRICIAN July 28, 1888.

J. B. YOUNG, President and Treas. B. K. JAMISON, Vice-President.

SOLAR CARBON & MFG. COMPANY,

Office, No. 69 Schmidt & Friday Building, PITTSBURGH, PA.

Well Selected and Good CARBONS made from Natural Gas. Process Patented.

BATTERY CARBONS OF ALL SHAPES AND SIZES A SPECIALTY.

Western Office, 175 Randolph Street, Chicago. Special Discounts on Large Orders.

TELEPHONES

FOR PRIVATE LINES.

The only Mechanical Telephone which has stood the tests and held out and given satisfactory service for the past eight years.

Send for Illustrated Catalogue and Prices.

ELECTRICAL GOODS OF EVERY DESCRIPTION.

Elgin Telephone and Electrical Supply Co.,

Room 7. Hubbard Blk., Elgin, Ill., U. S. A.

DO NOT BE DECEIVED

GENUINE GONDA POROUS CELL BATTERY COMPLETE.

By imitations marked Leclanché Disque or Disque Leclanché.
The term "Disque" was formerly used by us to designate a certain size of cell as distinguished from size No. 1 and size No. 2.
It has no reference whatever to the quality of the Battery.

THE CELEBRATED TRADE GONDA MARK. is the Genuine Battery.

GENUINE GONDA POROUS CELL AND ZINC.

It is unlike any other Porous Cell Battery made, or by whatever name called, and is immeasurably superior in efficiency and durability.

DO NOT BE IMPOSED UPON.

Insist upon being furnished with the Genuine Gonda Porous Cell, and if your dealer does not keep it send to us direct for prices. Do not use any zinc with our cell unless it is stamped with the word Gonda.

The LECLANCHÉ BATTERY CO., - 149 West 18th St., New York.

WIRES AND CABLES.

OKONITE
TRADE MARK.

CANDEE IMPROVED WEATHERPROOF WIRE.

A full stock of ELECTRICAL SUPPLIES of Every Description.

SEND FOR PRICES.

CENTRAL ELECTRIC COMPANY,

42 LA SALLE STREET, CHICAGO, ILL.

GILES ANTI-MAGNETIC SHIELD FOR WATCHES.

Office of Van Depoele Electric M'fg. Co.
Chicago, Feb. 16, 1886.

Anti-Magnetic Shield & Watch Case Co.

Gentlemen : — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good timekeeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.

Sure protection from all Electrical and Magnetic disturbances.
Send for descriptive circular.

"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
Prof. Phs. Dept., Cornell University.

The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers ; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and in operative on account of their susceptibility to the all-pervading magnetic influence.

AMERICAN WATCH CO.,
Waltham, Mass.

GILES BROS. & CO. 103 State Street, CHICAGO.

THE LIST OF SALES OF THE

Westinghouse Engines: Compound, Standard and Junior,

FOR THE MONTH OF OCTOBER, 1888,

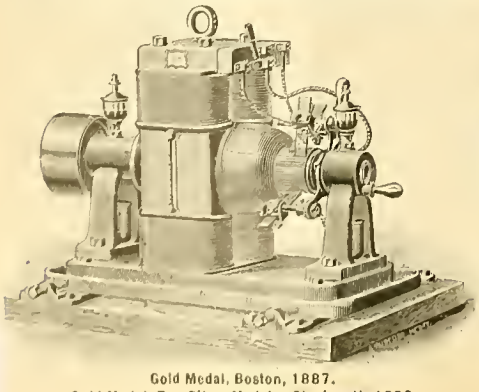
Is too long to publish *in extenso* as an Advertisement. Orders were received on eighteen working days, the five heaviest days yielding respectively, 16, 11, 10, 8, and 7 ENGINES EACH.

TOTAL, 86 ENGINES, AGGREGATING 3310 H. P.

Sales for August, September and October were over 200 ENGINES of all types, aggregating nearly *10,000 HORSE POWER*. Note in connection with the above exhibit, that our current advertising expenses for 1888 are about one-half that of any preceding year.

WHY IS IT?

WATERHOUSE THIRD BRUSH REGULATION



Gold Medal, Boston, 1887.
Gold Medal, Two Silver Medals, Cincinnati, 1888.

Varies the E. M. F. from the Armature Directly with the Resistance on the Lamp Line. The Perfection in Regulation attained by this method, enables us to furnish

THE BEST ARC LIGHT IN THE WORLD.

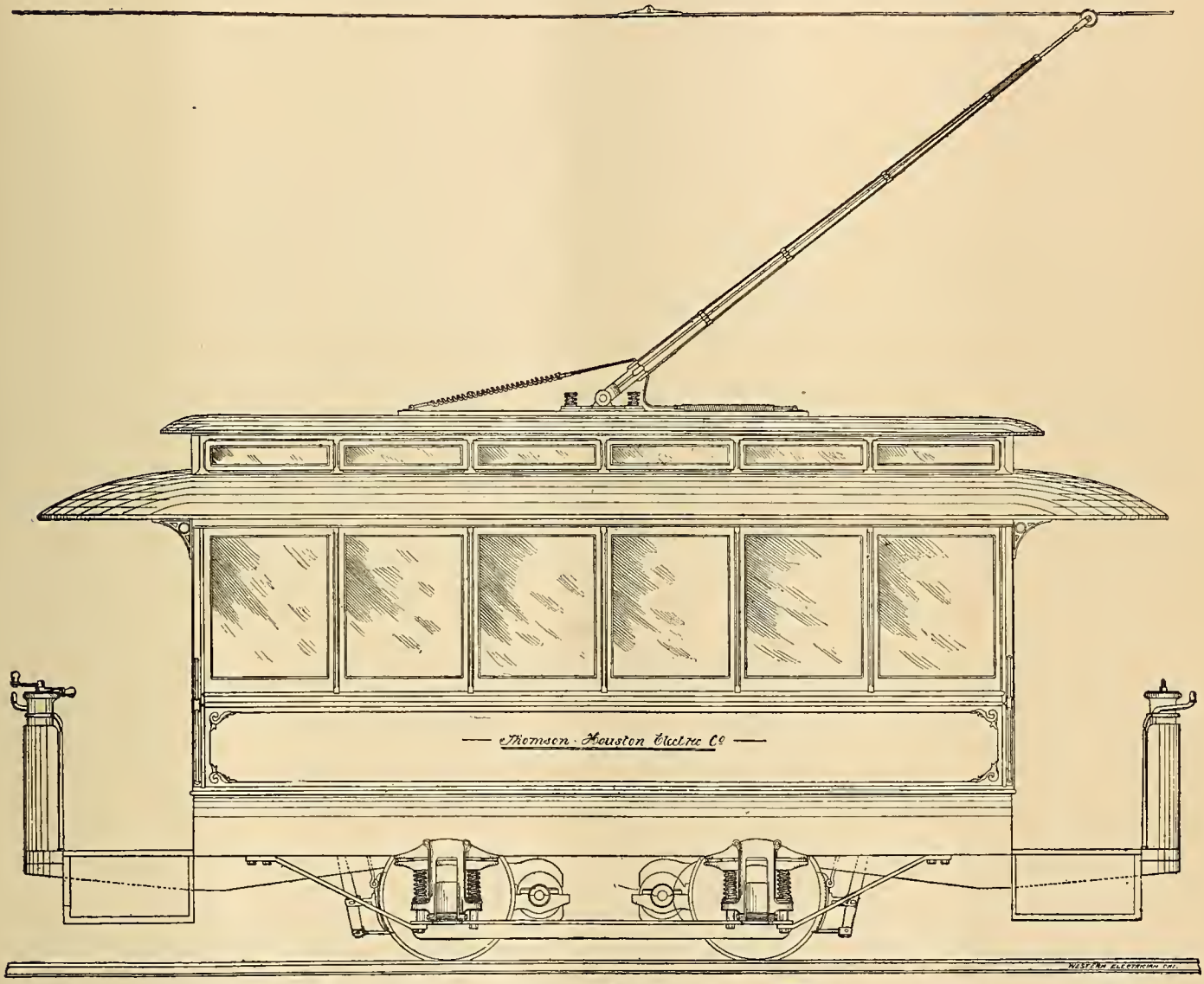
SEND FOR CATALOGUE.

THE WATERHOUSE ELECTRIC & MFG. CO.,

HARTFORD, CONN.

154 La Salle Street, - - CHICAGO, ILL.

The Thomson-Houston Electric Railway System.



Nineteen Roads in Daily Operation Under the Thomson-Houston Patents.

ALL MATERIAL IS NOW MANUFACTURED AT THE **FACTORY** *AT* **LYNN,** *MASS., THE LARGEST AND BEST EQUIPPED ELECTRIC FACTORY IN THE WORLD.*

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Thomson-Houston patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

MOTORS & ELECTRICAL EQUIPMENTS FURNISHED FOR MINING & OTHER SPECIAL WORK.

For Full Information and Estimates Address the

THOMSON-HOUSTON ELECTRIC COMPANY,

620 ATLANTIC AVE., BOSTON, MASS. 148 MICHIGAN AVE., CHICAGO, ILL.

E. M. F.

We had the pleasure last week of a visit from Mr. W. A. Kreidler, Western Electrician. We are happy to state that Mr. Kreidler is looking well and as hearty as usual.

Wire put up with the Gem Wire Cleats is held with a vise-like grip; at the same time both wire cleats and wire can be removed for use at another place without the least injury to either. Did you ever see 'em?

Xmas Presents for your friends—Combination Electric Bell outfits. Think about this.

SOLDERING SALTS.

Cheaper than Acid! Better than Resin!

Warranted to excel all other preparations for soldering wire joints and all metals. You make a mistake when you don't try it.

THE ELECTRIC SAFEGUARD.

Be wise to-day.

What do you think of the Stoddard Combined Rosette and Cut-Out?

Did you see our circular about the "New Patent Gas Attachment?" This is something you should know about.

PATENT COMMUTATOR CONSERVER.

Prevents sparking.

All danger and disadvantages to street intersection lighting removed by using the Dayton Lift and Tackle.

Try the Perfect Control Automatic Torch. The best machine yet invented for the purpose.

Try our No. 610 Ornamental and Useful Wood-box Bells—Black Walnut, Oak, or Cherry.

For a first-class Iron-box Bell use our No. 640.

Our No. 620 Iron Frame is the "Popular" Bell.

Quality First—Low Price Afterwards.

We try and combine 'em—and generally succeed. We sell reliable goods—goods that will do what is claimed for them.

Do you want any Blue Vitriol?

X WEATHER-PROOF LINE WIRE. X

We are asked, "Do you class P. and B. as a weather-proof wire?" YOU BET WE DO. And we have evidence, documentary and otherwise, to show that it is the best weather-proof insulation made to-day. We are perfectly well aware that all BLACK INSULATIONS are not weather-proof, and would caution our friends not to be misled by offers to "make a black insulation as good as P. and B." What is "as good as P. and B." before made, and on paper, will, perhaps, not prove so when manufactured and put to actual test. We can only add, try it, gentlemen, before accepting.

X P. AND B. IS WEATHER-PROOF AND WATER-PROOF. X

Use P. and B. When Constructing or Extending.

BELLS!

SEE CAT. NO. 645.

We have war paint on when it comes to selling bells. You know what that means. Do not buy before getting samples and quotations. Our bells are made on scientific principles, by experienced workmen, and out of first-class material. We have the best line of bells made, and are ready to meet competition in prices every day of the week. This climate is healthy.

BATTERIES

THE DIAMOND IS BY FAR The Best.

THE DIAMOND CARBON.

IMITATED BY MANY.

EQUALED BY NONE!

Who ever heard of the Diamond Carbon Battery "playing out" after a week's use? The Diamond Carbon Battery is the best—best by very long odds. Best and cheapest.

PUSH BUTTONS.

WOOD OR BRONZE.

Space fails us. See Catalogue No. 645 and write for quotations.

THE ELECTRICAL SUPPLY CO.

171 Randolph Street,

CHICAGO.

FACTORIES:

Ansonia, Conn.

BRANCH OFFICE:

505 Delaware St., KANSAS CITY, MO.

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H. M. BYLLESBY, Vice-Pres't and Gen'l Manager.
P. H. ALEXANDER, General Agent.

GEO. H. LEWARS, Secretary and Treasurer.
C. H. BARNEY, Auditor.
J. M. ROBERTSON, General Superintendent.

SAWYER-MAN ELECTRIC CO.

510 to 534 WEST 23d STREET,

NEW YORK,

MANUFACTURERS OF THE

CELEBRATED

SAWYER-MAN INCANDESCENT

ELECTRIC LAMP.

HIGH EFFICIENCY. ✣ LONG LIFE. ✣ NO BLACKENING.

LAMPS MADE TO FIT SOCKETS OF ALL LEADING MANUFACTURES.

PRICES GREATLY REDUCED.

WRITE FOR PARTICULARS.

FOR[illegible] WAYNE JENNEY ELECTRIC LIGHT COMPANY,

Fort Wayne, Indiana.

Manufacturers of the

SLATTERY INDUCTION SYSTEM

—OF—

INCANDESCENT LIGHTING,

—AND THE—

JENNEY SYSTEM

—OF—

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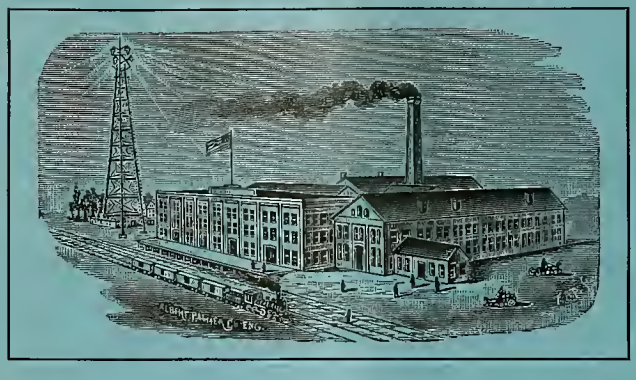

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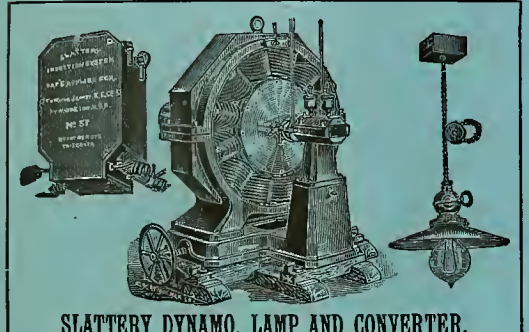

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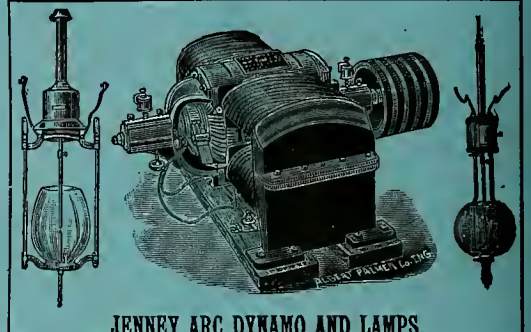

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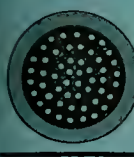

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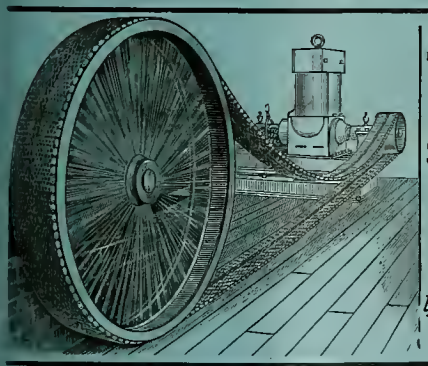

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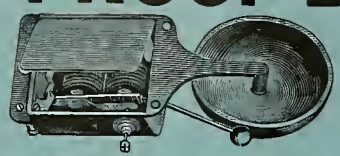
Superior to  All Others.

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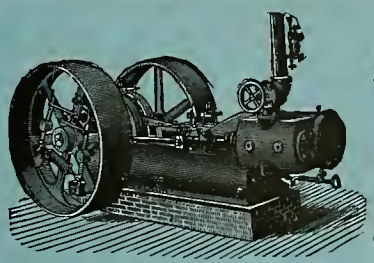

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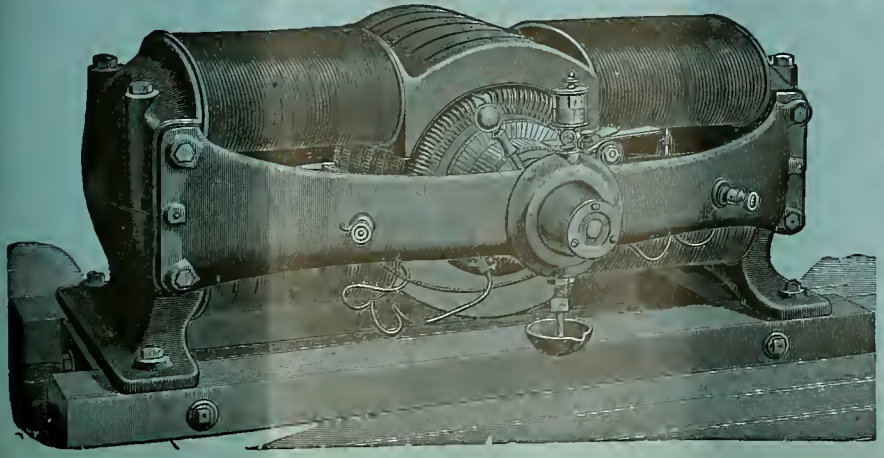

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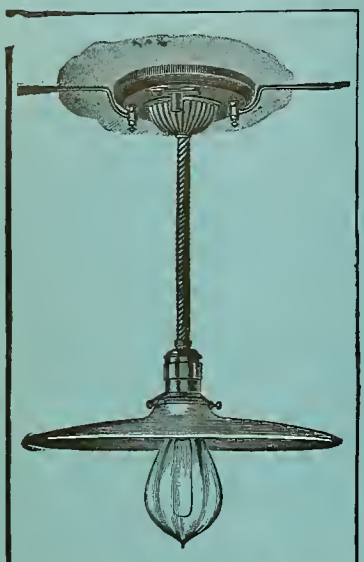

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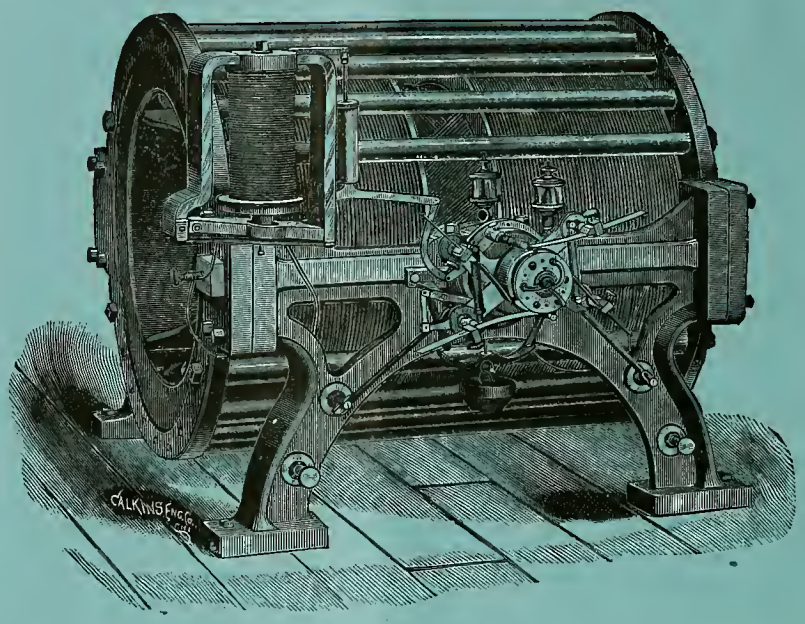

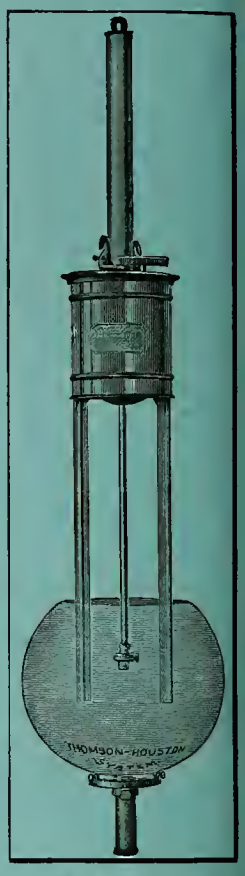

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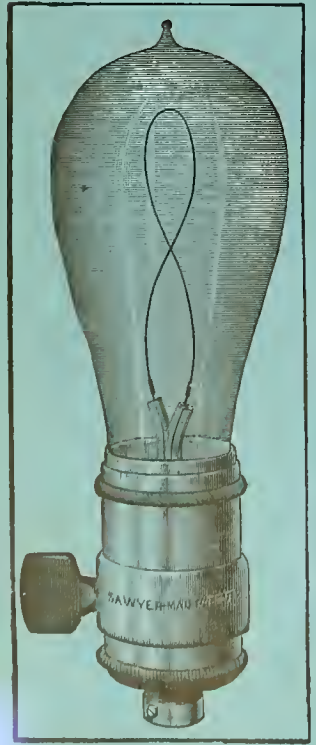

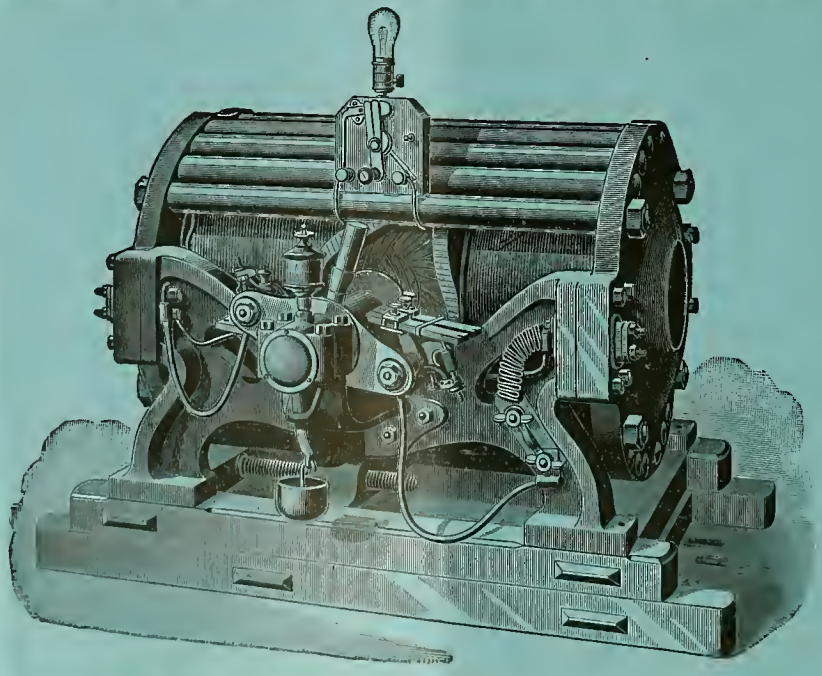

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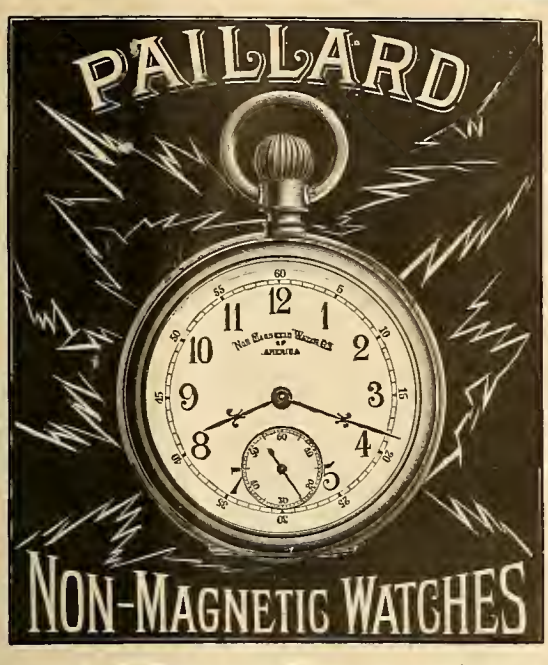

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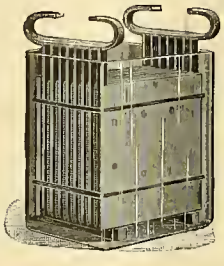

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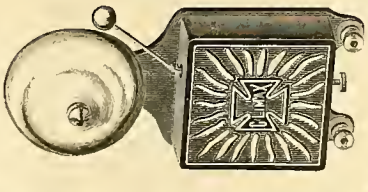
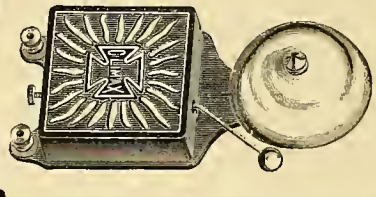
BUY  THE  BEST

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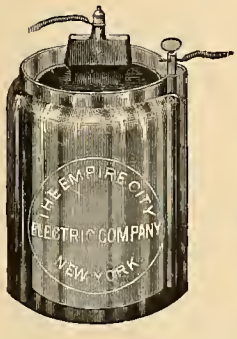

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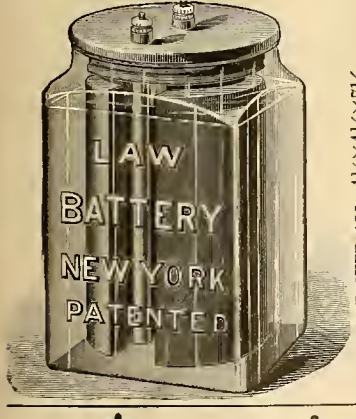

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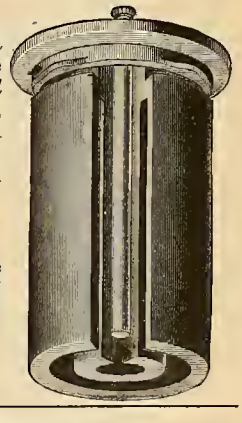

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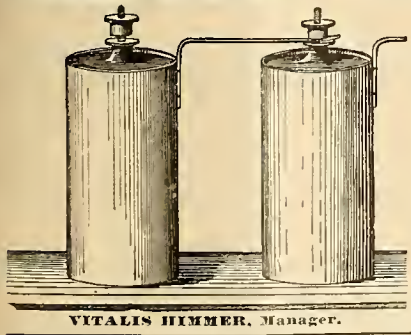

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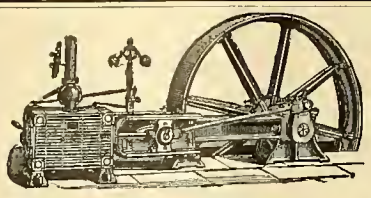

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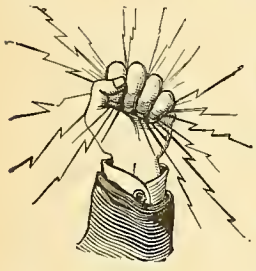

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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

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THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

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Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

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Edison Electric Light Co.,

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[Manufacturers under Patents and Applications for Patents controlling the sale and use of Alternating Current Electric Lighting Apparatus and Distributing Systems.]

The success of the Alternating Current System of Electric Lighting is demonstrated beyond question.

Note the sale of 132 Central Station Plants by this Company, aggregating a total generating capacity of 240,000 16-candle-power lamps, within the brief period of twenty-four months, together with the fact that out of these 132 Central Stations, 38 have increased their plant since starting.

IMPROVED LAMPS.

By reason of an improvement in the manufacture of Lamps which has been secured for the exclusive benefit of the users of apparatus furnished by the Westinghouse Electric Company, this Company will guarantee from its Apparatus and Lamps 50 per cent. more light from a given expenditure of power (fuel) than can be obtained with any direct current system.

ALTERNATING CURRENT METERS.

This Company's Meter measures the whole current by a positive mechanical movement.

It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

ALTERNATING CURRENT MOTORS.

Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

Small Motors for use on existing Alternating Circuits of this Company.

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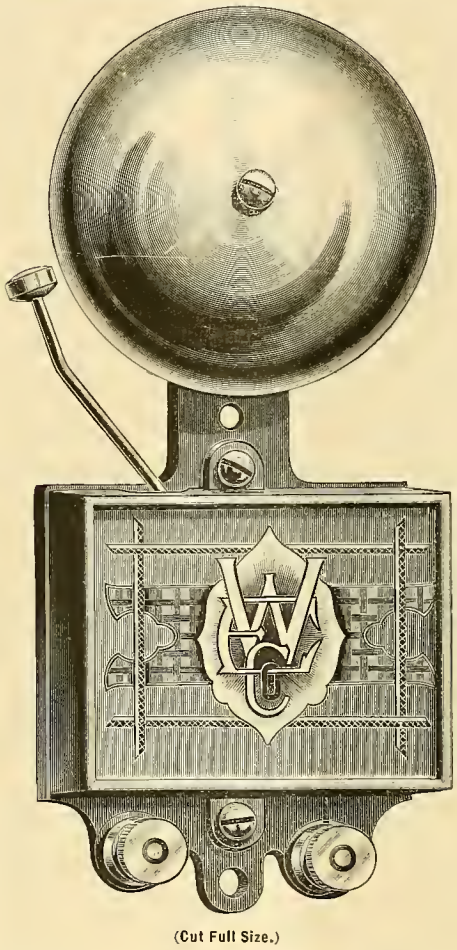
Quad Carbon Battery.

Prices upon Application.

New Style Iron Box Bell, No. 1006.



(Cut Full Size.)

Disque Battery.

Prices upon Application.

Bronze Push No. 1004.

Price, 75 Cents.

Sample Sent by Mail on Receipt of 65c.

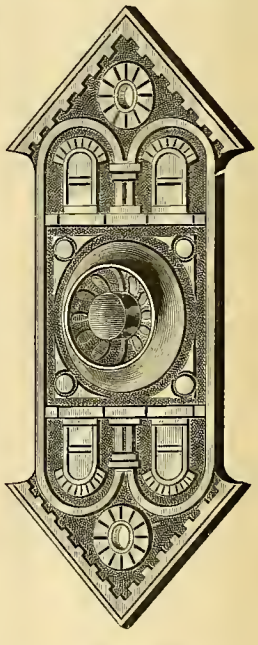
Agents for the Gassner Dry Battery.

Oval.

Cylindrical.

Medical.

Bronze Push No. 1003.



Price, 75 Cents.

PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, DECEMBER 22, 1888. No. 25

Chicago Telephone Question.

The delay of the finance committee of the Chicago city council in preparing a report upon the telephone question is due to the fact that Corporation-counsel Green, to whom the matter was referred, was confined to his house by illness. As soon as he was able to return to his office, however, Mr. Green began his examination of the question. He refused to make any statement, however, as to the probable course of the city council, and said the finance committee had referred several questions of law to him, and he would make an official report at an early day. Further than that he could say nothing, as he had no knowledge of the intention of the committee. It is thought, however, that the committee will recommend the council to secure the passage of an act of the legislature enabling the council to regulate the telephone rates, Corporation-counsel Green having given the opinion that the charter does not give the council that authority. In the meantime the telephone company will continue operations under the original Bell company, to which the franchise was granted.

At a meeting of the finance committee of the city council, December 15th, fully 400 business men were present to protest against further delay in the matter of settling the dispute between the city and the telephone company. One business man said he had placed an application for a telephone with the company two months ago, and had been unable to get it, owing to the failure of the council to act. The delay meant a loss of $500 to him in his business. A large number of druggists were present to plead for immediate action on the part of the council. The committee, however, adjourned without agreeing upon a report. A member of the committee said after the meeting: "We have tinkered with this business for a year. The city is out $35,000 on account of the delay. I will vote for the compromise ordinance, because by passing that instrument we will surrender none of the city's rights, and we will obtain $30,000 next year for extending the electric light plant, and we will accommodate hundreds of business men."

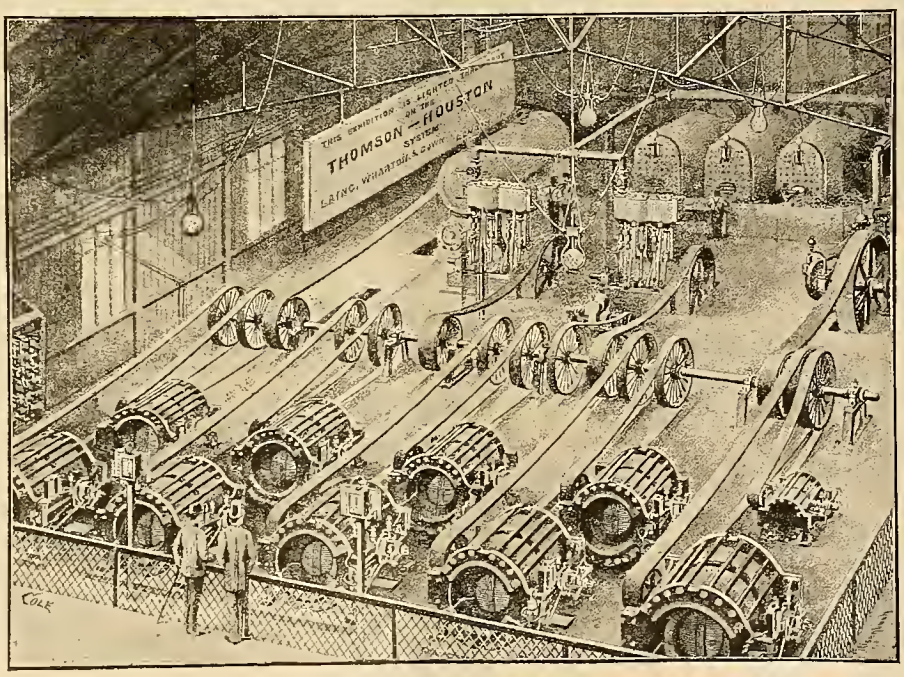
Another meeting of persons interested in the telephone controversy was held at the Grand Pacific while the committee was listening to the pleas of applicants for telephones. Cutting wires and tearing out boxes were the measures advocated at this meeting, and it was agreed to memorialize the legislature to empower the council to regulate telephone rates.

Chicago's Electric Lights.

Great activity has been manifested by the electrical department of the Chicago city government in establishing the new city plant, which it is hoped will be in operation on Christmas day. The boilers, engines and dynamos are in position, the work of stringing the wires has been almost completed, and the lamps have been placed in position and connected. City-electrician Barrett informed a representative of the Western Electrician that the start would surely be made on that day, "if we only have one light burning." He added that the work had been considerably delayed, owing to circumstances which could not be guarded against, but these difficulties had been overcome and he was jubilant over the outlook.

Thomson-Houston System at the Italian Exhibition.

It may be interesting to record the fact that the arc light installation at the late Italian exhibition at West Brompton was one of the largest installations of its kind in this country, and we give a bird's-eye view of the machinery employed, London *Industries* says. Originally the installation was intended to comprise 250 arc lamps, distributed throughout the buildings and grounds, and Messrs. Laing, Wharton & Down, the English representatives of the Thomson-Houston system, provided nine 35-light dynamos, which would give a reserve of two dynamos; but the number of arcs was continually increased until it reached over 300, thus leaving practically no reserve. Notwithstanding this, the electric light plant worked without any interruption chargeable to the dynamos, and the service was only partially interrupted on two occasions, once when the main belt of one of the 30-horse power engines broke, and when the remaining engines successfully worked in their overloaded condition; and once when, late in the evening, the belt on one of the dynamos gave way. As the circuits were arranged to overlap, this accident was hardly noticed and created no inconvenience. There were also two of the new Thomson-Houston glow-lamp dynamos in use, supplying between 300 and 400 glow lamps. As it will be seen by our illustration, the transmission of power between the engines and dynamos was by a single line of countershafting, to which all the machinery was belted.



THOMSON-HOUSTON SYSTEM AT THE ITALIAN EXHIBITION.

Fuel Oil Experiments in Chicago.

The question of utilizing fuel oil in place of coal has been occupying the attention of manufacturers throughout the country of late, and many experiments have been made. The result of these investigations will be watched with great interest by electric light companies. Not content with the experience of others, the Chicago Arc Light & Power company about three months ago began experiments for itself. A. F. Bennett, secretary of the company, in conversation with a representative of the Western Electrician, said: "We have been trying this fuel oil at one of our stations about three months, but unfortunately, we have been unable to give it a fair test. In the first place our arrangements were incomplete, we did not secure the proper burners, and our boilers were not so arranged, we found, as to be adapted to the new service. Then again, our men were not at that time as experienced as they now are, and we did not secure the results we had anticipated, but still there was a saving. Besides the saving in the cost of fuel, we dispense with the services of one man under the present arrangement, and also save $15 a month, which we formerly paid for removing ashes. That of itself is a saving of $75 per month. Then again, the fuel oil is clean as compared to coal. There are no ashes, no smoke, and the fire is far more regular. We hope now to obtain better results. You see we are in no way discouraged over the result of our experiments, but on the contrary see reason for expecting great results from the change."

The experiment of the North Chicago Rolling Mill company has proved far more successful. Operations under the new system were begun last week, and the results thus far have been very encouraging. Every arrangement had been completed, however, at the South Chicago station where the experiment was made. The trial here was made on an extensive scale, and in the matter of labor saving the report is very favorable. Formerly it took sixty-five men to work the battery of forty boilers at the company's works, wheeling ashes, shoveling coal, and attending to the fires generally. Now there are but ten, and the work of these men is altogether not so trying and onerous as one man would be called upon to perform under the old system. In regard to the comparative waste of boiler metal from the action of coal as against that of fuel oil, the difference is even greater. Experts who have tested both extensively, say that a boiler will last three times as long subjected to gas heat as it will heated by coal.

The German government has decided to establish a marine telegraph school, similar to that which already exists for the army.

Leavenworth Heisler Station.

The Leavenworth Coal company has a well-equipped electric light station. It is situated two miles from Leavenworth, Kan., at the coal pit of the company. The original order was for one hundred and sixty 30 candle power lamps. The plant was so successful that the capacity has been increased from time to time until the dynamos are supplying current for one thousand 30 candle power lamps. Fig. 1 gives a general view of the Leavenworth station. Fig. 2 illustrates the plan of wiring on the Heisler system. Fig. 3 illustrates the Heisler single wire series system.

Chicago Electric Club.

A meeting of the Chicago Electric club was held at the club rooms last Monday evening.

FIG. 1. LEAVENWORTH HEISLER SYSTEM.

B. E. Sunny, the vice-president, was in the chair. Dr. George W. Whitefield read a paper on the "Injurious influences of dissimilar metals used as filling material in the mouth," which is produced elsewhere.

The question of insulation was then brought before the club. C. C. Haskins, city inspector of electric lights, reported that he had previously sent notices to a number of gentlemen connected with electric light companies in Chicago, inviting them to attend a meeting December 4 to consider the subject of insulation. The following gentlemen were present at the former meeting: C. C. Haskins, F. B. Badt, Western Electric company; E. S. Hewson, United States Electric Lighting company; C. H. Wilmerding, Arc Light & Power company; H. Ward Leonard, of Leonard & Izard; George Cutter, Thomson-Houston company; B. E. Sunny, Thomson-Houston company and Arc Light & Power company; D. P. Perry, Sperry Electric company; G. A. Mayo, Van Depoele company; E. A. Sperry, Sperry Electric company; W. L. Abbott, National Electric Construction company. At the meeting of these gentlemen Mr. Haskins made a general statement of the object of the meeting. H. Ward Leonard presented a formula by means of which the amount of insulation required by any particular plant could be determined. The formula was as follows:

$$\text{Insulation} = \frac{E \times 10000}{C.}$$

In which E equals volts.
In which C equals maximum current in amperes.
In which insulation equals number of ohms to ground with metallic circuit open, and devices (in multiple arc plants) not in use.

A general discussion followed in which Mr. Haskins explained what the municipal law had previously been. The application of the formula to various special cases was noted. Mr. Leonard amended the formula in its application to mean each branch of the network in incandescent installations. It was urged that in its application to arc lighting the insulation should be for a unit length of conductor; for instance, one mile. Mr. Haskins stated that it was the "V" in the case of the arc and the "C" in the case of the incandescent that he was afraid of. Mr. Haskins then asked an expression of opinion from the gentlemen present as to the insulation upon line wires to be used, condemning in strong terms the use of the underwriters' wire. A general discussion followed, participated in by Messrs. Badt, Sunny, Cuter, Haskins, Leonard and Sperry. The weather proof wires were recommended. After several motions and amendments, a motion by Mr. Sargent, seconded by Prof. Badt, was unanimously adopted, namely:

"That the underwriters' insulation should be entirely discontinued in the city of Chicago for use in the distributionof electric currents for arc and incandescent lighting, and electric motors."

It was decided at a meeting just before the club was called to order, that the matter should be brought before the club. Mr. Sunny briefly outlined the previous action of the committee, as above, and asked for a general discussion of the matter by the full meeting.

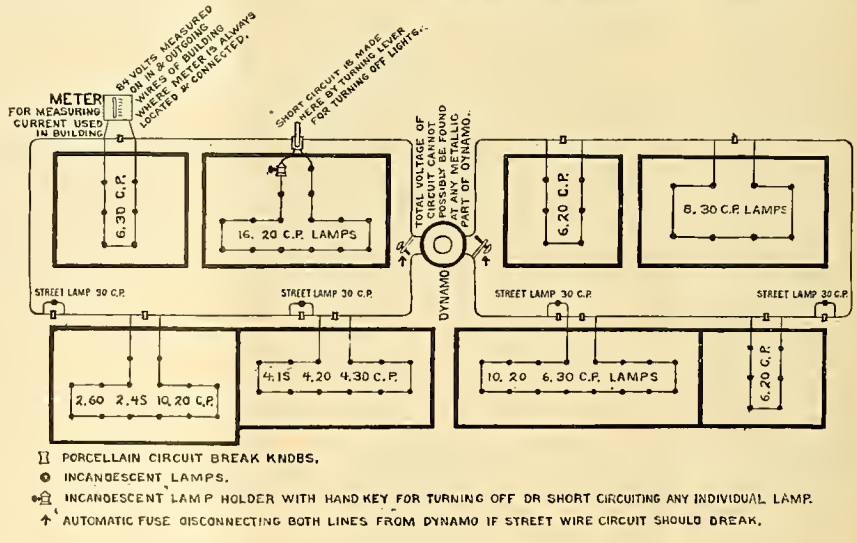


FIG. 2. PLAN OF WIRING FOR THE HEISLER SYSTEM.

F. B. Badt read a leader of the London *Electrical Review* of June 19th, 1888, on insulation of conductors, to the effect that the mere fixing of a certain insulated resistance per mile for certain electrical pressure was not sufficient; that also minimum of the thickness of the dielectric should be determined. He then read part of an article published in the same number of the *Electrical Review* on the insulation of mains for high tension, by G. A. Addenbrooke. Mr. Addenbrooke desires the thickness of the dielectric not less than one-eighth of an inch for 2,000 volts, and shows the reason why a thin wire should have the same minimum thickness of insulation as a thick wire. Mr. Badt concluded by stating that in his opinion the thickness of the dielectric should be considered in making a definite rule for the standard wire insulation.

Mr. Cutter coincided with the views of Mr. Badt and mentioned that as Mr. Badt had not touched upon the formula proposed by Mr. Leonard, that he assumed that Mr. Badt did not any more think that this formula was covering all the cases fairly; that he thought best to talk the whole matter over in the next club meeting and then refer it to a special committee to work out these rules.

Mr. Thompson mentioned the fact that the thickness of the dielectric was specified for all government work; that for instance on all the vessels of the United States navy, which have electric light installations, the minimum thickness of the dielectric was specified as to be $\frac{3}{32}$ of an inch.

After the discussion it was decided to postpone further consideration until the next meeting of the club, Monday evening, January 7th. The members were requested to prepare themselves to participate fully in the discussion.

Motor Service in New York.

The following extracts from an interview with Albert Gray in the New York *Sun*, gives an idea of the motor service in that city. Speaking of motors, he says: "We cannot make them fast enough to supply the demand. People have learned to depend upon a steady, constant supply, and in practice it is not attended with any more danger, indeed, not so much as is inevitable with the use of steam. Whatever can be done with steam can now be done with electricity. We can send out 2,000-horse power from this room. We will take a contract to run the printing presses of the London *Times* with electrical power from New York. The only limit is the size of the generators. We supply power to run a sewing machine for a cent an hour. The general prices are $4 a week for one-horse power, $6 a week for two-horse power, and $3 per week for each additional horse power. These prices are not absolute. They vary somewhat with certain conditions. It may be stated generally that the cost of electrical power is less than steam. The main advantage to those who use electrical power is that they do not need to invest capital. There is no more sense in buying a steam engine to get power than there is in building a gas house to get light. Of course, anybody who uses an immense amount of gas can afford to build a gas house; any one who needs enormous power can afford to buy a big steam engine. But for ordinary purposes it is much better in many ways to get power by the introduction of electric wires. There is the saving of the wages of an engineer. There is no dust, no consumption of coal or other fuel, no noise, no heat, no spattering of oil. The exact amount of power used is charged for and measured. It is available at any moment It can be turned on or off as easily as gas, water or steam. A one-horse power motor will run three Gordon presses and a cylinder press. A three-quarter horse power motor will run three Gordon presses. An eighth of a horse power motor will run a sewing machine for a cent an hour, or run a ventilating fan We have lots of these fans running in restaurants, hospitals, and factories. A one-horse power motor is about the size of a coal hod. The cost of running an ordinary passenger elevator by electrical force is about eight dollars a week."

At a meeting of the board of directors of the Non-Magnetic Watch company of America, H. W. Struss and A. C. Smith resigned as treasurer and secretary respectively. E. T. Gilliland, who has been identified with phonograph and telephone interests, was elected as treasurer, and Charles P. Bruch as secretary. A. C. Smith remains the general sales agent for the United States.

Chicago West Side Surface Road.

The street car facilities on the west side of Chicago are anything but satisfactory at present, and residents of that part of the city have for some time been demanding better service. Many methods of improving the system have been suggested, and an effort is now being made to introduce the cable system on an extensive scale. In view of the fact that the cable system on the north side has failed repeatedly at critical moments, the residents of the west side are not entirely satisfied with this proposition. C. T. Yerkes, president of the company having control of the present system, said to a representative of the WESTERN ELECTRICIAN that it had been decided to abandon horse power as soon as practicable. He said he had investigated several systems of propelling cars and thought he would introduce the cable system on the west side. His objection to electricity as a motive power was due to the fact that he did not feel that it was entirely developed. He had grave doubts as to whether the overhead wire system would be tolerated in Chicago or other large cities, and he did not favor the storage battery system.

Certain it is that Mr. Yerkes' views are not shared by representative west side property owners, and all recent experiments tend to confirm the practicability of utilizing electricity as a motive power for street cars.

The Proposed Hannahs Road in Chicago.

A largely attended meeting of west-siders was held in Chicago recently, to consider the Hannahs company plan of operating an electric road. If a franchise is granted the company proposes to employ electric motor. Samuel Kerr, representing the Hannahs company, which is desirous of securing the franchise, explained the position of the company, and said there was no doubt as to the practicability of the scheme. Mr. Kerr has since prepared an ordinance for submission to the city council, which provides that the proposed road begin at the west line of Canal street on Lake street and run thence westward on Lake street to Crawford avenue, at which point it will cross the city limits. It is further provided that work on the proposed line shall be begun within six months after the passage of the ordinance. The cars will be illuminated by electric lights. In speaking of their project, Mr. Kerr said: "We are all enthusiastic in our belief that we can successfully operate a line by electricity and compete with other roads, and we hope the council will grant us the franchise."

Electric Door Opener.

The accompanying cuts illustrate an electric door opener manufactured by the Empire City Electric company of New York. The appliance is simple in construction, but efficient in its action. All the wearing parts are made of steel. Little battery power is required to operate the appliance. Mortise and rim styles are made. In the cuts Fig. 1 gives a general idea of the door opener; Figs. 2 and 3 show cross-sections, illustrating the application of the device. In the former the door is locked, and in the latter unfastened. Fig. 4 gives the form of the push spring.

Dissimilar Metals Used as Filling Materials in the Mouth [1]

By Dr. George W. Whitefield.

"My curse upon thy venom'd stang,
That shoots my tortured gums alang,
And through my lugs gies mony a twang,
Wi' gnawing vengeance;
Tearing my nerves wi' bitter pang,
Like racking engines!

"When fevers burn or ague freezes,
Rheumatics gnaw or colic squeezes,
Our neighbors' sympathy may ease us
Wi' pitying moan;
But thee—thou hell o' a' diseases—
Aye mocks our groan."

Before going into the discussion of the subject of the paper, it will be well to, in as concise manner as possible, deal with some of the general facts that a dentist is called upon to explain if he wishes to educate his patients to a realization of the importance and value of these useful, necessary, and if properly cared for, beautiful organs—our teeth. No one can over-estimate their value if they are natural, taking the word in its broad sense; if they are as nature planned they should be, even, strong and sound.

Unfortunately, we seldom find this combination. We are, as Dr. Chance says, "unsound from our feet to our hair."

"The question is oft asked why our teeth will decay,
And what can be done that the trouble will stay.
'Tis easier to ask than answer, my friend;
Theories there are without number or end,
But still 'tis a question for study and care,
Nor can it be answered in full at the chair.

"You may go where you will, from tropic to pole,
Man's body's unsound through the sin of his soul.
Tho' this you may doubt, but the preacher says so,
And while science may try the contrary to show,
He the fact still asserts, that since the first pair,
We are all unsound, from our feet to our hair.

"Still much may be done to arrest and to stay
The causes at work in those teeth that decay;
That whilst a new body we cannot invent,
The wear of the old we can somewhat prevent;
And when you'll do your part, the dentist his share,
Teeth, otherwise lost, will be saved in the chair.

"When we do our part! Why, sir; what do you mean?
My teeth I keep brushed—don't you think they are clean?'
"Well, no, they are not, though to you they so seem."

The point last stated that has as far as I know no single fact to controvert it I will speak of after giving what I consider a rational theory of dentalcaries.

It is a pretty generally accepted theory that micro-organisms have a great deal to do with the destruction of the dental organs; this is a very plausible theory, and is in substance what our honored pathologist, Dr. J. V. Black, teaches. The mouth is peopled with colonies of micro-organisms, as can be easily demonstrated by scraping a particle from the neck of a tooth whose owner is satisfied that he keeps his teeth perfectly clean. By transferring this particle to a microscope slide, and properly adjusting the lenses, if they are of sufficient strength, you can discern the main characteristics of the different members of the menagerie. These are facts that can easily be proved by demonstration.

These colonies live on the debris left around the teeth, and, while some of them are harmless, others excrete lactic acid, that in this way deface and destroy our gems—our teeth. I will explain the action; micro-organisms find lodgment between the teeth and in the crevices of imperfectly formed teeth. Starch and sugar form their food, and they excrete lactic acid, which is a solvent of the inorganic portions of tooth structure, resulting in a roughening of the surface of the teeth, giving lodgment to larger colonies, resulting in increased destruction of the hard tissue, and thus the decay progresses. These ravenous creatures do not devour the tissue, but their excrement dissolves the tooth structure.

This statement of cause prompts the question of, how can we prevent this loss of our teeth in this disgusting way? Shall we do as I have heard boasters say, that they never brushed this horde of robbers from their mouths? Surely, if the laity fully realize the facts, more tooth-brushes would be in demand. Yet the brushes most often used fall very far short of what is required of them. Brushes should be small enough to reach the back teeth, the bristles stiff, and their rows far enough apart so they may pass between the teeth, and curved so that one can reach any part of the mouth, especially inside of the lower central incisors. The surfaces of the teeth are comparatively easily cleaned. It is between the teeth there is the greatest need of cleanliness, as some of these microbes envelope themselves, and are fastened to the teeth as a snail is to a leaf, with a gelatinous slime, that it requires force to dislodge.

How often shall we brush the teeth, and shall we use powder? As well ask how often the hands and face should be washed. Here in Chicago, the application of soap and water must be frequent to keep the skin clean. The same with the teeth; the conditions vary, and so should the treatment—keep them clean! If water will do it, that is all that is required.

Water without soap is not sufficient to cleanse the surface of the body; still we do not require laws to regulate the use of the soap. Why should we lay down rules for the use of powder, which is to the teeth as soap is to the surface of the body? Keep the teeth clean and wholesome with water, if you can; but, like soap, powder will remove stains that water will not efface. Use judgment; don't brush the prominent surfaces of the teeth easiest of access to cleanse those situated where, from the formation of the jaws, it is difficult to reach. One tooth is injured by overmuch care, where five hundred suffer from insufficient attention.

A splinter of wood, moistened and dipped in powder, can be employed to rub off stains where

[1] Read before the Chicago Electric club, December 17, 1888.

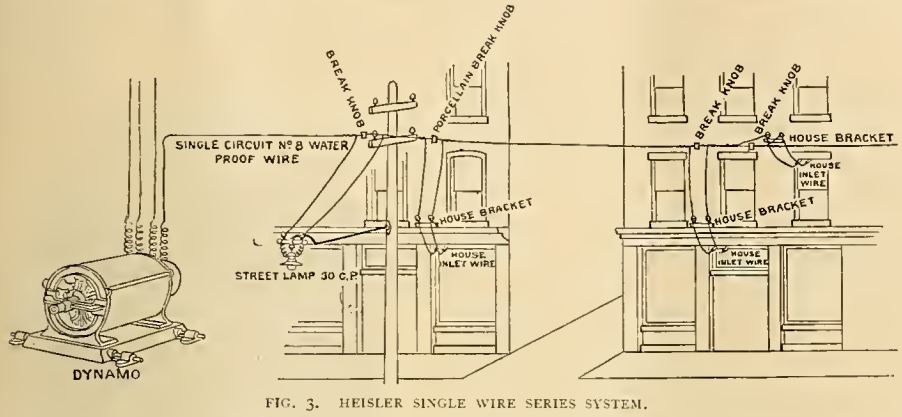


FIG. 3. HEISLER SINGLE WIRE SERIES SYSTEM.

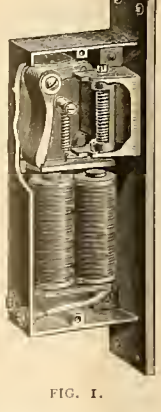


FIG. 1.

FIG. 2.

FIG. 4.

FIG. 3.

ELECTRIC DOOR OPENER.

the brush does not reach, but, by doing as you say, we will brush the enamel from the teeth.

How does the friction of the brush compare with the friction of one tooth upon another in chewing the food? And yet you do not cease chewing to prevent wearing the enamel from the teeth.

I will, in a few words, explain the anatomy of the teeth. Above the gums the teeth are covered with enamel that is thickest (about 1-16 of an inch) at the top of the crown, tapering to a feather edge at the cervical margin (neck).

The bulk of the tooth is composed of parallel rods of dentine (a bunch of lead pencils might be taken as an illustration), then the pulp in the chamber which conforms nearly to the outer contour of the tooth.

The pulp is composed of bloodvessels, connective tissue and nerve filaments, and is often erroneously called the nerve. What I have

FIG. 1. MICRO-ORGANISMS FOUND IN THE MOUTH.

stated has but remote bearing on the subject of this paper, still I hope it may be of interest and profit. I will now prepare the way for the discussion of the real subject of this paper: "The injurious influences of dissimilar metals used as filling materials in the mouth."

Our thinking men in the dental profession are trying to devise means to neutralize and arrest the causes that destroy the teeth. Fillings of different kinds have been and are being used to repair the loss of continuity of tooth structure to protect the exposed parts, and restore the contour of the organ. Prominent among these fillings are gold, tin cements and amalgam, or, as it is sometimes called, silver. It is composed in varying proportions of tin and silver, with a small amount of gold or platinum amalgamated, as the term implies, with quicksilver. There are also amalgams of copper, and some containing zinc. It is needless to go into the theory and history of the art. We will consider the subject as it now is.

In a general way, I will now introduce the subject of this all-pervading mysterious force we call electricity. Different qualifying names are employed to designate the kind of electrical manifestations, as magnetic, frictional or static, galvanic, voltaic or dynamic, thermal and animal electricity.

It will be out of place for me to attempt to explain what has baffled the sages of the past and scientists of the present.

We find that all molecular disturbances give rise to disturbed electrical equilibrium, all motion tends to produce this condition. We notice the result only when the conditions are favorable, that is, when the conditions are such that the equilibrium is not too easily re-established.

Electricity is termed positive (+) when it has an accumulation of electrical force to impart, negative (—) when it will require such an amount of electrical energy to restore the electrical equilibrium. The difference of electrical conditions is termed the difference of potential.

Difference of potential is a difference of electrical conditions, by virtue of which work is done; by the positive electricity in moving from the point of higher potential to that of a lower potential, and is measured by the unit of quantity of (+) positive electricity thus transmitted.

The passage of the electricity from the point of higher potential to that of lower potential is termed electrical current, and the bodies along which it passes are conductors. The opposition to the passage of the current is termed the resistance.

The following, from an article in the WESTERN ELECTRICIAN of March 17th, by F. B. Badt, will make these points clear:

"In order to understand the action of what is called the electric current, we will consider two reservoirs of water connected by a pipe, Fig. 1. The electric current may be likened to the flow of water through this pipe from the higher to the lower level. The unit of current strength, also called the rate of flow or intensity, is the ampere. In the illustration we would say the water is flowing through the pipe at the rate of one gallon per second. In speaking of the electric current, we would say it has a strength of, say one ampere.

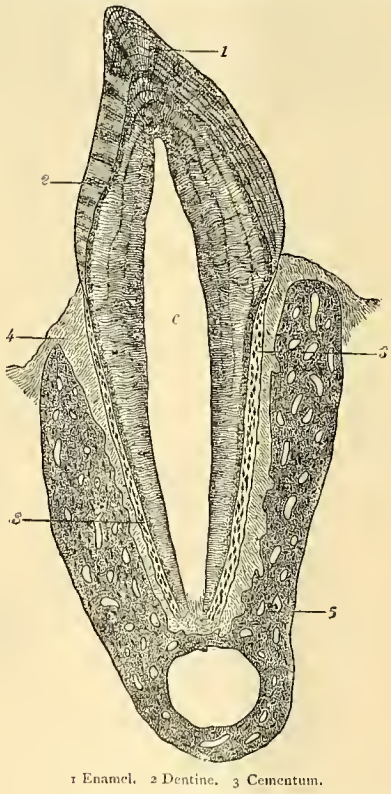
"The unit of electromotive force, also called electrical pressure, or tension, or difference of potential, is the volt. In the illustration the head of water, or the difference between the levels *A* and *B*, is similar to the electromotive force.

"The unit of resistance is the ohm. Resistance may be compared with the friction of the internal surface of the pipe offered to the water. It follows that the more cross-section the less friction, and the less cross-section the more friction, for the same volume of water flowing through the pipe in a given time.

"In the following only the terms current strength, electromotive force—frequently written e. m. f.—and resistance, will be used."

Conductors are good or bad as they convey or resist the passage of the electrical current; different metals vary in their conductivity, aluminum and copper being high in the scale, while German silver and steel retard the current; moisture is a good conductor, while glass, kerite, rubber and dry air are among the poorest conductors; the resistance varies with the length of the circuit, the conductivity and cross section of the conductors.

As the current is the same strength through-



1 Enamel. 2 Dentine. 3 Cementum.

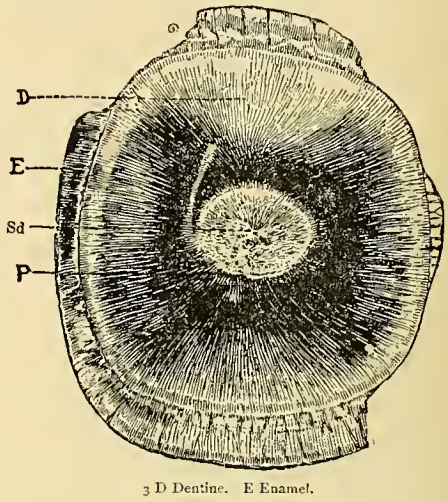
FIG. 2. VERTICAL SECTION OF A CUSPID WITH SECTION OF LOWER JAW AND ATTACHMENTS.

out its entire length, it naturally follows that the larger the conductors, other things being equal, the less the resistance, and on the other hand, the lessened surface or poorer the conductor, the lessened current and reduced activity of the battery. When the current is too great for the conductor there is a transformation of force; the electric current, in its struggle to overcome the resistance, generates heat, which varies according to the current and the conductor; the heat may become so intense that the conductors will glow as in the incandescent lamp or cautery snare. Heat generated in this way is now employed in electric welding and for the fusing of metals requiring a high temperature, such as platinum, iridium, etc.

Magnetism derives its name from the place where magnetic ore was first found—Magnesia, Asia Minor.

Fractional or static electricity is of but little interest to us as a profession, although often, in a dry atmosphere, it may be a very annoying companion by the dental chair, when each movement of the operator produces by friction a difference of potential between the operator and the patient; then if the discharge is by way of an instrument to a filling or moisture in a cavity of a tooth, the result, to say the least, is unpleasant, and often quite startling if the patient, by jumping, upsets the instruments.

Frictional electricity is to galvanic electricity what a red hot needle would be to a large, moderately heated crow-bar; the crow-bar contains more heat than the needle, but one has volume, the other intensity. Frictional electricity is so intense that it will jump through air, the length



3 D Dentine. E Enamel.

FIG. 3. CROSS SECTION OF ROOT.

of the spark being governed by the intensity of the current.

Galvanic electricity, on the contrary, will traverse the circumference of the globe rather than leap a short space. Galvanic, voltaic or dynamic electricity is the particular manifestation of this force most interesting in a practical way to the dentist. The current derived from the battery is called galvanic or voltaic, in honor of the experimentors who, less than 100 years ago, discovered the method of generating and collecting the force through chemical action. It is this manifestation of electrical energy that is employed in the arts, consequently the name dynamic.

Where the extensive use of electricity is required, the dynamo is employed for economical reasons. Batteries consist of positive (+) and negative (—) elements, immersed in an exciting fluid, or fluids. The fluid employed varies according to the construction of the battery and kind of work to be done, being acid or alkaline; though even pure water will generate a current, if two metals are immersed in it, where one metal is more readily oxydized than the other. (Note the fact that action would take place if the elements were composed of two samples of amalgam, if one was composed of less oxydizable metals than the other).

The positive (+) element of the battery is the one on which the exciting fluid acts, that is, the fluid destroys the positive (+) element, molecule by molecule, while the negative (—) element should sustain no loss of structure. If the negative (—) element is acted upon by the fluid, counter currents are generated which interfere with the usefulness of the battery. I spoke of the resistance of the conductors; the fluids of the batteries impose resistance, termed the internal resistance. The electrical energy of a battery is the energy of the current less the internal resistance and the resistance of the circuit. The resistance, both internal and of the circuit, modify the action of the battery. If the elements are connected with wire of sufficient size to convey the current, the electromotive force will be reduced in proportion as the length of the wire is increased or the size (cross section) of the wire is proportionately reduced; while, if the elements

touch in the fluid, the action is most violent, and the batteries soon become polarized, that is, the surface of the positive (+) element becomes so changed that the fluid ceases to affect it, or the fluid becomes so saturated with the waste product of the combustion of the positive (+) element that action practically ceases, unless provision is made for it by having the fluid constantly renewed, as in some kinds of batteries designed for constant work.

When the circuit is opened or closed shock is felt, if the current is of sufficient strength; this shock is the result of the accumulated energy being suddenly discharged; different devices are made use of to produce this result, such as the induction coil, constructed with a vibrator, which rapidly makes and breaks the circuit; an example of this is the medical battery, and the

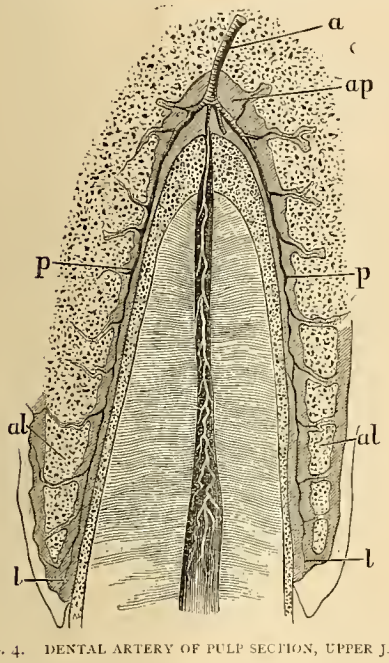


FIG. 4. DENTAL ARTERY OF PULP SECTION, UPPER JAW.

Ruhmkorff coil; the current produced in this way is called the Faradic.

Now, to apply the foregoing to the battery formed by dissimilar metals in the mouth, where the fluids of the mouth are the exciting media, gold will be the negative (—) element, as the fluids of the mouth have no action on this metal; the positive (+) element is the baser metals, whether used separately, as tin, or as most commonly the combination of mercury with tin, silver, zinc and copper, as in the amalgams in use.

With gold and tin to form the voltaic pair the base metal soon becomes coated and the current practically ceases, but, with the common forms of amalgam, the mercury performs the same office in the mouth that it does in the laboratory; it presents the metal in a form that is easily acted upon by the exciting fluid.

We always have good conductors in the fluids of the mouth, containing, as they do, mucous and various earthy salts, while often the fillings touch in the same tooth, or as approximal fillings of gold in one tooth, and amalgam in the other.

We always have good conductors, although the resistance varies in each individual case according to the character of the secretions, or the situation of the fillings.

The action will vary according as the conditions are changed; naturally where food is left between teeth to decompose, the acid resulting from such fermentation will form a more exciting media than normal alkaline saliva. Where a filling is left rough and jagged, overhanging and irritating the gums, it presents an exaggerated surface to be acted upon, besides, by irritating the gums, it causes a secretion from them that forms an excellent exciting fluid. This is unfortunately the too frequent result of careless operating.

Now, what of it? Is this only theory? Are these statements founded on scientific facts? Can they be established by proof? The WESTERN ELECTRICIAN of February 11th says, in reference to a talk I gave before the Chicago Electrical club:

"Dr. Whitefield, before the Chicago Electric club Monday evening, succeeded in settling a question that has been in dispute among dentists as to the electric action of amalgam and gold fillings in the same tooth, or even in the same mouth.

"That current was generated by amalgam and gold fillings even when they were insulated from each other when placed in water, was conclusively shown by bringing a galvanometer into circuit. The point is one that may be combated, but the evidence produced by the galvanometer cannot be controverted."

Now if there is galvanic action, what harm can it do? Let us quote from an article on amalgam in the November *Dental Review*, 1887:

"Now the question arises: Shall we ever use amalgam and gold in the same tooth, and if so, why? And if not, why not? There has been such varied teaching in the past in regard to this subject, that it is time the old errors should be exploded and scientific teaching presented to our students of to-day. The old way was to put both amalgam and gold in the same tooth if it seemed necessary, but never let them touch each other or grave results would follow. After seeing such methods pursued for a term of years, we find that in spite of the teachings grave results did follow, which ultimately resulted in the loss of the gold filling, while the amalgam remained comparatively sound, or, rather, the tooth structure surrounding the amalgam filling."

This is correct; but to go on and see the writer's following statements:

"We have found that if the two metals touch in the electric battery, there is no longer a current, it is dead, no shock is produced, and it is just the same when the metals are in a tooth in the presence of an acid, as it is out of the mouth in the laboratory. Therefore, we found, first, from an unpleasant experience, and later from theory, that, if amalgam and gold are placed in the same tooth, they should have an uninterrupted communication, should be in complete apposition, so that no electric or galvanic action can take place because they touch each other."

Let us consider these statements and see if they harmonize with the laws of physics. Now, if the elements touch (the fillings) there is practically no resistance in the circuit, consequently the battery's action is most violent, up to the capacity of the battery to generate current.

The writer says no shock is produced. He is right; the current flows evenly through the short circuit, so the equipoise is practically maintained, and shock is produced only when the current is interrupted, when an accumulation of energy is suddenly discharged.

To be fair, I will essay to point out what has misled my friend into making these rash statements:

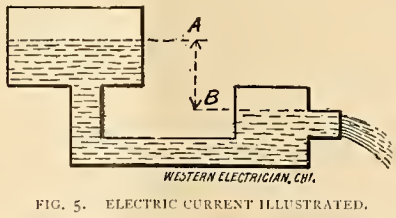


FIG. 5. ELECTRIC CURRENT ILLUSTRATED.

If gold and amalgam touch in the same tooth there is practically less destruction around the gold filling. This is easily explained, as the galvanic action is so violent that the surface of the amalgam filling is soon destroyed; that is, all the baser metals are consumed from the face of the plug, leaving often the silver, gold or platinum of which it is composed, on the surface, which practically changes the amalgam to nearly a silver surface, thus raising it to nearly a negative metal, while beside this, the coating protects even the surface of the silver.

This statement holds true with regard to very old plugs of amalgam; their surface is no longer amalgam, it is negative metal.

But at what fearful cost are such old fillings raised to the dignity of negative elements.

We will now note some of the harmful phases of this subject

First: Galvanic action has a tendency to accelerate the blood flow, producing hyperemia and hyperesthesia, and in some cases violent nervous phenomena. This is especially the case where, from the situation of the fillings, the energy is accumulated at the positive element, then suddenly discharged, producing shock, as each can demonstrate by touching a bit of zinc or the blade of a pen-knife to a filling in your own mouth.

Second: The current is generated from all parts of the elements that come in contact with moisture, and is not protected by a coating. The portion of the amalgam filling that is protected by tooth structure becomes so coated that there is practically no action except on its exposed surface; on the contrary, gold remains bright on all its surfaces, and as moisture pervades the whole tooth, no matter how well the filling is inserted, moisture will reach it by way of the inter-tubular spaces, consequently electrolytic action can take place from all portions of the gold element, naturally causing considerable destruction around the gold filling, and this is not all—electrolytic action takes place. Among the commonest elements found in the mouth is chloride of sodium (salt); galvanic action readily breaks up this compound, the chlorine liberates oxygen and unites with the hydrogen of the water, forming hydrochloric acid (other acids may be formed in this way, such as sulphuric, nitric, etc.) The electrolytic action and the acids thus formed are sufficient to roughen the surface of the teeth to give lodgment to colonies of Dr. Black's "microbes."

Is this all? No! Chlorine in its parent state will readily unite with the mercury of the amalgam, and the chlorides of mercury may be formed in sufficient quantities to produce symptoms of mercurial poisoning in those susceptible to its influences; these salts of mercury may also explain the immunity from decay of teeth stopped with ill-fitting amalgam plugs, the germicidal effects of the mercury being sufficient to prevent colonization by micro-organisms, and consequent destruction of the tooth.

The oxygen might, from peculiarities of the individual case, unite with other salts than those of the teeth, and the same with the acids. We all know that the neglect some mouths get would be total destruction in others. The elements that usually produce decay seem to be inert in their case, and the same condition undoubtedly explains why electrolytic action that would destroy in one case is apparently harmless in others, although such cases are in the minority.

The usual result of placing amalgam in the back teeth, while gold is placed in the front teeth, of children, will explain why the gold fillings have to be renewed so often; also, that in the electrical action is a clue to the oft-repeated tale brought us by the laity that amalgam stands better than gold, as the amalgam still remains and the gold fillings, that have been replaced several times, are loose again.

If amalgam must be used, use those grades that will readily become coated, as the coating will reduce the galvanic action, protecting the plug from the fluids of the mouth, except where attrition and brushing keep them bright. Gold and amalgam, in fact any metal should be avoided for teeth that are of such soft structure that the pressure produced in inserting gold would tend to break down the structure of the tooth, while metals never stand well in teeth of very soft structure; in fact, you can expect to prevent water flowing under the edge of a board resting on the ends of the blocks in a cedar block pavement in the street, as to expect to exclude moisture from a soft tooth with a metallic filling, as moisture is bound to penetrate between the tubuli. Even the normal plasma exuding from the tubuli will have a tendency to assist the destruction of the hard structure when it becomes vitiated, as it must in the temperature of the mouth, as it is a foreign substance when lost from the tubuli, as is the blood that weeps from abraded gum tissue.

The cement is the only filling material that should be used in such teeth. If you will use this material, in the course of eighteen months or two years the tooth will be found quite hard and capable of proper manipulation, to prepare it for the king of metals and the king of filling materials—gold. A tooth treated in this way will not be as sensitive, and the fillings will last.

Western Electrician.

EVERY SATURDAY.

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CONTENTS OF THIS NUMBER.

PAGE

Chicago Telephone Question 313
Chicago Electric Lights 313
Thomson-Houston System at the Italian Exhibition, Illustrated . 313
Fuel Oil Experiments in Chicago 313
Leavenworth Heisler Station, Illustrated 314, 315
Chicago Electric Club 314
Chicago West-side Surface Road 315
Proposed Hannahs Road in Chicago 315
Electric Door-Opener, Illustrated 315
Dissimilar Metals used as Filling Materials in the Mouth, by Dr. Geo. W. Whitefield Illustrated 315 316 317
Editorial 318
Electric Executions 319
Absolute Vacuum as a Non-Conductor and Its Bearing on Electric Theories, by Dr. P. H. Van der Weyde, Illustrated .. 320, 321

DEPARTMENTS.

Correspondence 321, 322
The Electric Light 322, 323
The Electric Motor 323
The Telephone 323
The Telegraph 323
Electrical Patents 324

THE New York correspondent of the London *Electrician*, writing under date of November 17th, says:

You will remember that in my letter recently I referred to the purchase of the Sawyer-Man property and rights by the Westinghouse company, and said that this step would involve new relations between the Westinghouse and Thomson-Houston companies, the latter in its incandescent business having operated largely under the Sawyer-Man patents. It was evident that this change would bring about either a closer affiliation between the two great companies mentioned, or would throw them wider apart. When I inform you that the Westinghouse company has now purchased the Waterhouse arc system, and that the contract between the Westinghouse and the Thomson-Houston companies is reported to terminate on the 30th of this month, you will see at once that the two companies have agreed to differ, and that each will stand on its own bottom for electric light business in both departments. In a great many quarters the alliance now terminated was looked upon as the first step towards a wider and stronger combination, and it is evident, in that the points at issue were too numerous and important to be reconciled, even in the case of two companies, that the rupture rendered altogether improbable the formation of a union of thirty or forty other conflicting interests.

In speaking of the "union of thirty or forty other conflicting interests," the correspondent refers, of course, to the many rumors which have been current for the last few months in regard to the formation of a gigantic electric light trust, which should include every manufacturer of arc and incandescent electric lighting apparatus in the United States. The conclusion of the correspondent is probably correct, as from all present indications the formation of such a trust, which has from the beginning seemed to many impracticable and improbable, is relegated still further to the future, if, indeed, it is ever to materialize.

More practicable, perhaps, than a trust, in the full meaning of that term, would be a working arrangement between the different manufacturing companies by which they should all agree not to sell arc or incandescent electric lighting apparatus below a certain price per light, and by which they should further agree to keep out of territory already occupied by another company.

That the competition in the electric lighting business in this country has been carried to such a point that many plants are sold at prices leaving no profit to the selling company, is a well-known fact. The matter is still further aggravated by the fact that the selling companies do not hesitate, in drumming for business, to enter towns already furnished with an electric light plant, and endeavor, by cutting prices and by every other means in their power, to oust the existing plant, and replace it with their own apparatus. The tendency of this is, of course, to render the plant of the existing local company valueless, and to destroy the confidence of capitalists in the value of local electric lighting plants as investments. This reacts injuriously on the electric light manufacturing business, inasmuch as it makes investors timid about putting their money into either local or manufacturing plants.

There are so many conflicting interests to satisfactorily adjust that the formation of an electric light trust in this country is a difficult and, perhaps, an impossible thing to bring about. But it ought to be practicable to make such an arrangement as is outlined above, by which a minimum price, below which electric lighting apparatus shall not be sold, is agreed upon, and an agreement put into effect by which local electric light investments are safe from competition, and remain paying investments. Under such an arrangement the electric lighting companies would go into the market and sell on the merits of their apparatus, and not on the basis of trying to see who can give to the customer the largest number of old dollars in exchange for the fewest number of new dollars.

An arrangement of this sort, which shall check the present competition in prices between the manufacturers, and render safe the investments of the local electric lighting companies, is worthy the prompt and earnest attention of the leading spirits in the electric lighting industry.

DR. WHITEFIELD'S paper read before the Chicago Electric club will be read with interest. He gives practical suggestions in reference to the care of the teeth, and follows with an argument against the use of dissimilar metals for filling material. His point is that the presence of two metals in the mouth leads to a generation of an electric current, which proves to be an exceedingly destructive agent. This is a subject in which Dr. Whitefield is greatly interested. He has addressed the club on the same general topic before, and has given experiments before dental societies in support of his position.

The Chicago *Times*, in a recent editorial, suggests that an international electrical exposition be held in Chicago next year. That paper says: "The old Exposition building would be an excellent place for holding the proposed display. An electrical railway could run in front of the gallery. The large stationary engine could be employed to generate electricity for all the purposes required. Every kind of electric light could be displayed in different parts of the building, so that their comparative merits could be shown. One of the side rooms could be used for illustrating the new process of welding by electricity. An electrical exposition here might be productive of a great amount of good."

THE Chicago city electric light plant will probably be in operation on Christmas day or a few days later. It is an improvement which excites no little public interest, as Chicago has been somewhat behind the times in the matter of street illumination. The plant will be enlarged from time to time until the western metropolis has an unequaled street-lighting service.

IT is reported that efforts are being made to secure at Elkhart, Ind., the introduction of Professor Gray's telautograph system. The Cushman telephones have been in use in that city, but according to the decision of the court the exchange must suspend business at the end of the present month. It is proposed if the arrangements for the introduction of the new means of communication can be made, to employ the existing circuits.

A HIGHLY interesting paper by Dr. Van der Weyde appears in this issue. He treats of the absolute vacuum as a non-conductor of electricity, and of the importance of the fact in its bearing on electric theories. In treating of the latter division of his subject the doctor emphasizes this point: "Heat and light will both pass through a vacuum perfect enough to obstruct absolutely the passage of electricity. If there were such a thing as an electric fluid it would surely pass through any empty space, and we are therefore driven to the conclusion that the presence of matter is as absolute a condition for the transmission of electricity as the presence of air is an absolute condition for the transmission of sound; and there is as little necessity to accept the hypothesis of the existence of an electric fluid as there is for the hypothesis of a sonorous or caloric fluid."

C. T. YERKES of the West Division Street Railway company of Chicago, in an interview which appears in another column, expresses his disinclination to employ any electric motors on the West Side system. His objection is that the electric system is not developed, and he considers all trials of electric motors as experiments simply. In view of the recent successes of both the overhead wire and storage battery systems, Mr. Yerkes' utterances seem strange. The press in all cities where electric systems are in operation have almost invariably agreed that the change from horses to electric motors has wonderfully improved the character of the street car service, and the daily press, as Mr. Yerkes will probably admit, is not backward in criticising street car facilities. Street car managers the country over believe that electricity is the future motor power, and Mr. Yerkes will unquestionably find before long proof enough to convince him of the availability and desirability of electric motors.

AS THE law substituting electricity for the rope in the infliction of the death penalty in New York goes into effect January 1st, and the question of the best means to be employed in conducting the executions is provoking the greatest interest, a few months ago the Medico-Legal society of New York appointed a committee to investigate the subject. The report favored the employment of an alternating current with a potential between 1,000 and 1,500 volts. The committee recommended that the prisoner be bound on a table, or on a chair. One electrode should be inserted in the table or on the back of the chair, so that it would impinge on the spine between the shoulders. The head should be secured by a helmet fastened to the table or chair, and to this helmet the other pole should be so joined as to press against the top of the head. This report was considered at the last meeting of the society, and an interesting report of the discussion will be found in another column. The electricians who spoke were not, to say the least, enthusiastic over the report of the committee, neither did they seem to regard electric executions with marked favor.

Electric Executions.

The annual meeting of the Medico-Legal society was held at the Fifth Avenue hotel, New York, on the evening of December 12th. It was an occasion of unusual interest. A paper by Henry Guy Carleton on "Death by electricity in capital cases" was read, and a discussion followed of the committee's report on the best method of executing the law putting to death criminals in capital cases by electricity. The meeting was called to order by Clark Bell, president, at 8 o'clock. After arranging the preliminaries for the election, the president announced that Mr. Carleton had been hastily summoned to Washington and could not present his paper in person, but had placed it in the hands of Dr. Sillman, who would read it and explain the diagram. Mr. Carleton's plan as shown seemed to embody all of the blood-curdling features of previous devices for the same purpose, with some additional attachments, the object being to transmit an alternating current of 3,000 volts through the victim's head. The report of the committee was then taken up and an attempt was made to adopt it as read, it being already printed and in the hands of the audience. Some important amendments had been made to it, however, and a serious electrical error corrected, so that it was deemed proper to read it in full.

By special invitation of the president, there were present a fair representation of gentlemen interested in electrical affairs, among them being Dr. Schuyler S. Wheeler, Dr. Otto A. Moses, Chas. W. Price, Francis W. Jones, Ralph W. Pope, George M. Phelps and Joseph Wetzler.

Dr. Moses being called upon, said that he had expected a little interval to elapse before being asked his opinion on the subject. He desired to suspend judgment until an opportunity had been offered for others to present their views. He regretted that electricity had been selected as a death-dealing agent just as it was about emerging from the sea and being introduced into homes as a useful and trustworthy servant. Electrical engineers had been too much engaged in the introduction of electricity to meet the public demand, to make any protest against the passing of this law. He thought it would be wiser for the society to refrain from hasty action, as it might be necessary to undo the work which had already been done toward making electricity the agent for capital punishment. His first and strongest objection to its use was that it was not necessary that it should be used for the purpose. There were other cheaper and better means of accomplishing the same end. The doctor then proceeded to criticise the report of the committee, and said it was evident that the instruments used were not reliable. He did not see any reason for specifying the use of the alternating current for the work in question. It was the electrolytic action of the current which killed, and it was well known that the alternating current would not decompose water.

The chair called on Ralph W. Pope for his opinions. Mr. Pope stated that he considered it unfortunate that electricity had been decided upon as the proper agent for infliction of the death penalty, and that its use had been approved by law to go into effect on the 1st of January, without seeking the advice of electrical engineers until the eleventh hour, when nothing which they might say would be of any avail. This matter had been in the hands of physicians who, if all reports were true, were well versed in the art of killing as well as of preserving life. The principal element of barbarity in the existing method was that of fixing the day on which a criminal was to be executed. It was one of those decrees of an all-wise Providence that in the natural course of events none of us was aware of the time when he was to terminate his earthly existence. It might be to-day, or to-morrow, or next week, and in the face of this uncertainty our lives were passed in comparative freedom from anticipation of the fatal day. Had it been arranged otherwise, and had each of us been made aware of the exact length of his earthly career, life would be a period of continual misery. In this respect we might profitably follow the French practice, where the day fixed for execution is unknown to the victim, but he is awakened from a sound sleep, and in a few moments all is over. He believed that a similar provision had been made in the law under consideration, but the use of electricity had apparently made it essential that certain elaborate preparations should be made which added to the very objectionable features of the whole business. If he had been called upon for suggestions as to the most humane method of execution, he would have said that the cell of a condemned prisoner might be sealed and filled with gas of some description, at an hour when he was asleep and upon a date which had not been made known to him. He had no preference to any particular kind of gas, but he presumed that question might be readily settled. He would, however, personally object to water gas on account of its obnoxious smell. If it were true, as had been alleged in the report of the committee, that 200 lives had already been sacrificed in the electric lighting business, he saw no necessity for introducing these very elaborate preparations for death. The very fact that the victim must be strapped down and the current conveyed carefully to a vital part of the body was in itself proof that doubt existed as to its adaptability for such a purpose. It was true that the death penalty could be inflicted by electricity. He did not think it proper, however, nor even necessary, to exaggerate the dangers arising from its use for public purposes. It was not, however, responsible for those disasters in which scores of victims were killed and maimed at one time, as is frequently the case in railroad accidents and steamboat explosions. The report had suggested that the alternating current be used. He considered this an unjust discrimination against a system of electrical distribution which had been adopted by two or three different companies, and which was bringing electric lighting into more general use. He was well aware of all the dangers which had been attributed to this system of lighting, yet he had occasion two or three times a week to turn on lights of this character, and he felt no apprehension of sudden death. Its possibility was only one chance in a million or more, not by any means as probable as the fatality incident to crossing the streets of New York city, where every car and truck driver appears intent on running down every foot-passenger who crosses his path. There had been a call for suggestions as to the proper method of applying electricity. In reply to this he had nothing to offer. The law had been passed and was to go into effect. The best plan would no doubt be devised by those who were interested in such a subject.

Dr. Schuyler S. Wheeler being called upon, felt that he was obliged to differ from some of his electrical friends as to the disgrace attached to the use of the electric current for this purpose. The rope had long been used in executions, yet we did not object to using it for clothes lines and other domestic purposes. The same might be said of steel which was still more closely interwoven with our daily lives. It had been his privilege, or rather his discomfort, to witness some experiments in showing the effect of continuous and alternating currents on living animals at Columbia college. He had been a doubter up to that time, but he had been satisfied by those and more recent experiments that fatal effects could be more certainly produced by rapid alternations of current.

George M. Phelps characterized the whole affair as being sensational; that there were equally effective and more quiet and dignified methods of producing the same result, and he did not consider the proposed plan any improvement.

Francis W. Jones stated that he had made some experiments in measuring the resistance of the human body, and believed that it was an error to suppose that the absolute resistance could be determined. The resistance decreased with the electromotive force of the current used in the measurement. It was his belief that the electrodes should be applied at the back of the neck and at the base of the spine. The reflex action of the current would then act upon the brain, and this was a line of less resistance than that suggested by the committee.

Dr. Moses suggested that the electrodes be applied to the eyes, this path offering the least resistance, and the optic nerve being in the most intimate connection with the brain.

C. A. Doremus said that an effort had been made to substitute suffocation with carbonic acid gas for drowning for disposing of condemned dogs, but that after exposure for a half hour, and after being placed in a cart the driver had been surprised to have his load of canines, supposed to be defunct, suddenly revive on their way to their final resting place. The committee had pursued its investigations very carefully, and he believed that an alternating current of 1,000 to 1,500 volts would accomplish the desired result.

Dr. Jacoby objected to the elaborate arrangements which had been proposed for execution, and which he believed were wholly unnecessary. He thought some plan should be devised for effecting the connection without the knowledge of the victim. It was the shock that killed, and he believed it was a mistaken idea to suppose that the alternating was preferable to the continuous current for the purpose.

Harold P. Brown, electrical engineer, was called upon and availed himself of the opportunity to explain why he had entered into these investigations. He had originally given it his attention because of the deaths which had been caused by contact with electric wires and lamps in this city. He had been attacked by the advocates of the alternating system, and he was called upon to defend himself, which he did by undertaking to prove the truth of his original statement. He denied that he had any connection with the Edison company, but in his distress Mr. Edison had kindly offered him the use of his laboratory. He did not propose to do anything to retard the introduction of electric lighting, but on the contrary it was his idea to make it more safe, so that these accusations of danger could not be brought up against it. In reply to the inquiry why the alternating system predominated in the table of tests, as given in the committee's report, he desired to say that a large number of cases in which it was not fatal had been omitted. He admitted that he had been aroused to a feeling of resentment because of the unjustifiable attacks upon his motives. The device he had advised using in connection with arc lighting circuits had not been patented by him, and he offered it as a free gift to the public.

Dr. Peterson, chairman of the committee, was called upon to conclude the discussion. He said the committee was grateful for the criticism of their report. He asserted that the committee was actuated entirely by the interests of science, and gave a history of his connection with these experiments, beginning with his being called upon by Mr. Brown to assist in making the investigations which had been referred to.

Upon being put to vote the report of the committee in favor of the use of an alternating current of 1,000 to 1,500 volts was unanimously adopted.

In adjourning the meeting at an early hour in order that more time could be given to the banquet, the president took occasion to remark that he believed the standing of the society was a sufficient refutation of the intimation that it was being influenced in any manner by the relations of the different electric lighting companies to each other.

The discussion seemed to point to the necessity of placing the execution of the law in the hands of a competent electrical engineer who will carefully attend to all the details in order to make the new departure a practical process.

James L. Woolworth has commenced action against the Union Pacific railway company, on behalf of the Western Union telegraph company, to prevent the cancellation of the contract between the companies, under which the telegraph company operates the lines along the railroad company's road. A hearing will be granted before the United States Circuit court at Leavenworth, Thursday, December 27th. It is claimed that in 1860 the Western Union, in connection with the Pacific Telegraph and the California State Telegraph companies, constructed lines between Omaha and Salt Lake. Subsequently the Western Union, by consolidation with other companies, became invested with the sole right to operate these lines, and was further authorized by act of congress to extend its lines along the track of the Union Pacific as fast as it should be constructed. In September, 1869, the Union Pacific, becoming dissatisfied with the joint use of the system, leased its lines to the plaintiff, but afterward, under a plea that such an act was justified by its charter, took the leased lines into its own hands. Plaintiff states that it has reason to believe that the Union Pacific is contemplating further acts in derogation of this lease, including a seizure of the lines between Omaha, Ogden and Denver.

Absolute Vacuum as a Non-Conductor and its Bearing on Electric Theories[1]

BY DR. P. H. VAN DER WEYDE.

The historical exhibition which I furnished at the late American Institute fair contained several series which for want of space could not be separately shown, as would have been desirable, if space had permitted. In fact, everything was to a great degree mixed up for the reason referred to.

Among these series, electricity in vacuo formed a prominent and important feature, and because this is a subject so little understood and even misunderstood by the majority of electricians, and is also neglected in the textbooks, I felt induced to take this for my subject, when I was requested to address the society.

An additional reason was that it is of some practical importance, not so much in regard to its mechanical applications, as for the understanding and explanation of a great number of natural phenomena.

I will treat the subject historically, and therefore begin with calling your attention to the experiments of Nollet, recorded in his little book published in Paris in 1753, and illustrated with carefully engraved figures. His experiments consisted in passing a current of static electricity through glass flasks, from which a large portion of the air had been previously removed by the air pump. He found that the electric current passed as a luminous stream which was very bright when the room was darkened, while luminous pencils were thrown off toward the sides of the flask, if they were touched by the fingers or any other conductor of electricity.

FIG. 1.

Some thirty years later a variation of this experiment was contrived, consisting of a strong glass tube of about two or three inches diameter and three or more feet long, provided with brass caps at each end, which could be conveniently attached to the air pump and exhausted. As the exhaustion proceeded, the rarefied air in the tube became a conductor of electricity, while this conductivity appeared to improve in proportion as the air was more exhausted. At last a regular stream of electricity was seen to pass through the tube, which stream resembled strikingly the luminous colored streams seen in the aurora borealis, wherefore such a tube was called the "aurora tube," and under that name is found in most philosophical collections.

This apparatus was exhibited at the fair, the exhibit consisting of an old historical air pump, made about 1780, with the aurora tube screwed on the top of it. A few other smaller devices of a similar nature were less conspicuous, and about them I wish only to remark, that, when using an ordinary air pump; it appeared that the conductivity of the air increased in proportion to the amount of exhaustion; hence the impression became prevalent that if we could only form a perfect vacuum, we would have the best of all conductors, and this idea is, unfortunately, even at the present day, shared by several prominent electricians who have not had the opportunity to keep themselves posted in regard to the discoveries made during the last few years, especially those made by Crookes, Gassiot, Spottiswoode, Gordon and others.

I must not omit to mention that before the latter discoveries Geissler, in Germany, began to furnish investigators with a great variety of glass tubes of various fanciful shapes, made of different kinds of glass and filled with various gases and vapors, exhausted by the air pump or by being heated, and then sealed up by the blow pipe, while platinum or aluminum wires were inserted at the extreme ends, so as to conduct the electric current through the rarefied gases inside. As those tubes exhibited a series of striking and beautiful phenomena, they became very popular, and no physical collection is considered complete without a set of such tubes. They give occasion to exhibit the auroral phenomena, and similar ones of the same character without the trouble of continually working the air pump

I had two sets of such tubes on exhibition at the fair; one was extra large, the tubes being three and four feet long, and another set of tubes as many inches in length, and which I shall have the pleasure to exhibit to you tonight, being much easier and safer to transport than large tubes.

I will now proceed to make a statement of the facts as they are. They are startling and difficult to explain without the knowledge of the new conceptions of Professor Crookes regarding the nature of matter in the four different conditions, in which it presents itself to us.

The facts referred to are: The atmosphere in its ordinary condition is a very good non-conductor of electricity, provided it is perfectly dry and under a pressure equal to a mercurial barometric column of 760 millimetres or higher.

It is an important consideration, that if the air in which we live were a good conductor of electricity, man could never have become acquainted with electrical phenomena, as then static electricity could never have been collected, studied and experimented with; as this form of electricity was the key to the other different forms, the latter would never have been discovered.

When rarefied by the air pump to a quarter of the normal pressure, the insulating qualities of air are not so good, and when reduced to a pressure of 10 or 20 millimetres it is a good conductor and exhibits the phenomena referred to before. As this is about the limit attainable by an ordinary air pump, it is very natural that experimenters became possessed of the idea stated above, that the conductivity of the air would keep increasing as the exhaustion proceeded, but after the Sprengel mercurial air pump was invented, by which the air can be exhausted to a thousandth of a millimeter of mercurial pressure (which is about equivalent to one-millionth part of ordinary atmosphere pressure), it was found that the capacity of the air to show the auroral phenomena in the usual way ceased.

The electric current then behaves in a very different manner, as it radiates in straight lines and cannot turn corners, so that when the tubes are beat it gives occasion for very striking and novel phenomena, which were first brought forward by Professor Crookes in the tubes which are known by his name.

The difference between the Geissler tubes and the Crookes tubes is, that in the first the vacuum is very imperfect. In the Crookes tubes it is about a thousand times better, while if we succeed in making the vacuum a million times better, the conductivity of the air ceases absolutely. To accomplish this we must aid the function of the Sprengel air pump by some chemical device which will remove the last remnant of air. It then becomes an absolute non conductor, which ordinary atmospheric air is not, because it is po sible to pass currents of high tens'on in the form of an electric spark through the densest and driest air.. In the absolute vacuum, however, it is impossible to pass, over the space of a quarter inch, a spark which, when leaping through air, will be six or more inches long

I exhibit here such a tube in which the two platinum wires are brought together within a distance of scarcely a quarter inch. In this tube a vacuum did exist so perfect that it was impossible to pass a spark through, which through air would leap over a distance of more than six inches. I found that the spark would rather pass over the outside of the tube for that distance than go through the interior. In order to satisfy myself that no trace of electricity passed through the interior space of a quarter inch, I connected one of the platinum wires with a Leyden jar, wound a brass chain half way around the middle part of the tube, and connected this brass chain with the ground, in order to prevent any electricity from reaching the Leyden jar through the air along the outside, but I was not able to obtain the least trace of a charge in the Leyden jar. Later I increased the strength of the current more and more, until at last something happened in the tube which destroyed the vacuum; something volatilized, covering the sides of the glass interior with a blackish deposit, which may perhaps be platinum black, a thing which may not be impossible, if we consider that the electric discharge furnishes us the highest temperature which we can possibly produce by any means.

For more than twenty years I have preached this non-conductibility of a perfect vacuum, as it was proved by experiments with the Ruhmkorff coil, by de la Rive and du Moncel.

It has not a little surprised me that the priority of this discovery is so remote as I found it to be, and that so important a fact as that of the non-conducting power of a perfect vacuum has been overlooked and ignored for nearly a century after it was proved by experiment.

It is also a fact, known for more than a century by expert barometer-makers, that the luminosity which shows itself in the dark in its vacuum, when a barometer is moved up or down in order to cause the mercurial column to oscillate in the same way, is only seen when the mercury has been boiled in the tube to a moderate degree; when the vacuum is made too perfect it shows itself feebly, or not at all, the same as is the case when the vacuum is contaminated with watery vapors.

So much for facts; now for the theory which explains them, and for which we are indebted to Professor Crookes. It gives us an inside view of the nature of matter in the conditions in which it presents itself to us, and is based on the theory of Dalton, that all matter consists of an immense number of infinitesimal particles, called atoms, which are indestructible and in continual motion, which latter is also indestructible.

Astronomy teaches that in the planetary system we find a condition of things which are far beyond our ordinary conception based on our experience about things falling under the daily immediate observation of our senses. First, the distances at which the celestial objects are placed are immense in proportion to their size, stupendous as it appears to us. Secondly, they are in a continuous motion, which is indestructible. Every planetary system is to us a perfect "perpetuum mobile."

Modern chemistry teaches the same doctrine in regard to ultimate atoms, which constitute that which we call matter. First, the distances of these atoms are also very large in proportion to their size, which is infinitesimally small beyond our conception; secondly, these small particles or atoms are also in a continuous everlasting motion, as indestructible as is the motion of the planetary bodies.

As a concise statement of the modern philosophical conceptions in regard to this subject we say that, like the chemists of the past century proved, that apparent destruction of matter was only a transmutation of form, so the physicists of the present century have proved that apparent destruction of motion is also merely a transmutation of form, a change in the mode of motion; mass motion changed into molecular motion, which reveals itself as heat, light, or electricity, or, *vice versa*, any of the latter forces into one another or into mass motion. Of this transformation the steam engine and the modern dynamo are forcible illustrations.

The great Swedish chemist, Berzelius, more than half a century ago expressed similar views, when he declared that the heat and light we see in an electric discharge, say in a stroke of lightning, is not the electricity itself. He states most explicitly that the restoration of the electrical equilibrium which, when destroyed, gives rise to what we call electrical phenomena, causes the evolution of sudden light and heat in the bodies through whose medium this restoration of equilibrium takes place, which light and heat then radiates and diffuses itself according to the ordinary well-known laws of radiation and convection.

Crookes, in order to explain the peculiar behavior of electric discharges through his highly exhausted tubes, teaches the doctrine that our conception of three states of matters, solid, liquid and gaseous, is incomplete; he says that there is a fourth condition, which he calls radiant matter. He teaches as follows:

In solid bodies the atoms are in a state of rest; that is to say, as far as their relative position is concerned, but each atom oscillates to a greater or lesser degree. If the amplitude of the oscillation is small, we call the body cold; if the amplitude of the oscillation is large, we call the body hot; and in so far, Crookes' theory agrees with what Tyndall has popularized in his well-known work, entitled "Heat as a Mode of Motion."

When the amplitude of the oscillations becomes so great that the atoms turn over and commence to rotate around their centers, the body reaches its melting point, and becomes a liquid. Therefore, in liquids the atoms are not rigidly fixed to certain positions, but can freely roll over one another, and this constitutes the difference between solids and liquids.

When the velocity of the rotation becomes greater and greater, we say that the liquid is becoming hotter, and when from some cause or other this motion is still further increased, a new set of phenomena begins. The atoms are projected into space, and in place of rotating they are propelled from the liquid, and also repel one another, and as millions upon millions exist in the small space of a cubic inch, collisions take place by billions, and the body enters in what we call the "gaseous" condition.

In considering the motion of the atoms of gaseous matter, we enter the other extreme of the conception of great and small. It appears that the number of atoms in one cubic inch of the common air we breathe is represented by a series of more than twenty figures, which particles or atoms are in constant continual collision to the number of ten million per second, while the velocity is so great that, if moving in a straight line, they would pass through a space of eleven thousand feet in a single second, thus surpassing the velocity of sound ten times. This is the nature of the third or gaseous condition.

The fourth condition, attained by the Sprengel air-

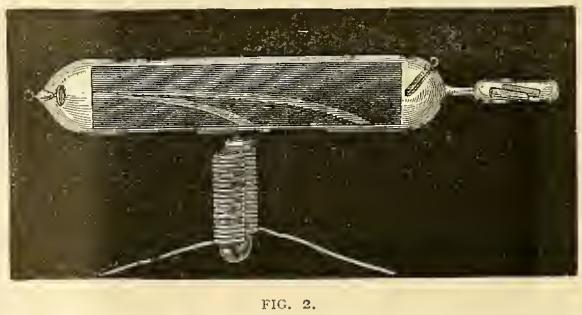

FIG. 2.

pump, is called by Crookes radiant matter. It is reached when the exhaustion proceeds so far that there are so few atoms left as to make the collisions exceptional; then the atoms will move in straight lines, and encountering no mutual hindrance to their motion they will follow the laws of electric repulsion and *radiate* from the point charged with electricity; hence matter in this condition is called "radiant matter."

Now we come to the most interesting feature of our consideration, namely, the chemical device referred to above, and intended to remove this last trace of air; recourse is had to the strong chemical affinity of potash for carbonic acid. The exhausted tube is filled with carbonic acid gas and again exhausted, and this process repeated in order to make sure that no atmospheric air is left, but only very rarified carbonic acid gas. A recess is connected with the tube, undergoing the operation, in which recess is placed a small stick of pure caustic potash. This recess is heated by a spirit lamp, so as to drive out the carbonic acid which the potash may contain, and then the vacuum is again made. The last remnant of carbonic acid which the air pump cannot remove is then absorbed by the potash, when this is allowed to cool down. In this way the absolute vacuum is produced, through which no electric current can be made to pass.

The bearing of this fact is of the utmost importance in regard to our conception of the nature of electricity. It is

[1] Read before the N. Y. Electrical Society.

generally admitted that the theory of the existence of a caloric fluid is erroneous, and that heat is merely a peculiar mode of motion, as referred to above, and this view is adopted, notwithstanding there is no experiment known serving to demonstrate that heat cannot be transmitted through a space absolutely devoid of all matter. Heat and light will both pass through a vacuum perfect enough to obstruct absolutely the passage of electricity. If there were such a thing as an electric fluid, it surely would pass through any empty space, and we are therefore driven to the conclusion that the presence of matter is as absolute a condition for the transmission of electricity as the presence of air is an absolute condition for the transmission of sound; and there is as little necessity to accept the hypothesis of the existence of an electric fluid as there is for the hypothesis of a sonorous or caloric fluid.

Air being the ordinary vehicle by which sonorous vibrations are transmitted, a proper degree of exhaustion will arrest this transmission, and any common air pump can be made to prove that sound is with difficulty transmitted through a partial vacuum, and not at all when the vacuum is somewhat nearer to perfection. This experiment is acknowledged to be intended for a demonstration that the molecules of the air are the media for transmitting sound, that without such a medium there can be no sound, and that there exists no peculiar sonorous imponderable fluid which pervades the air, and should be the cause of sound transmission. When now we see that more highly rarefied air behaves toward electricity in exactly the same way as the lesser rarefied air behaves toward sound, namely that at a certain degree of rarefaction, the transmission becomes more imperfect and at a certain point stops entirely, we are driven to the conclusion that electricity as well as sound is merely a peculiar form of motion of ponderable matter.

The conventional method of calling electricity a fluid must be understood to be only for the sake of convenience in explaining the phenomena presented An argument in favor of this custom is, that electric currents behaved like water in two respects, namely, moving under greater or smaller pressure, and in greater or smaller quantities What is water is called pressure or head is in electricity called electromotive force, and as hydraulic pressure can overcome great obstacles, so electromotive force overcomes great resistances. It is measured by a standard unit, which is properly called after the illustrious Italian who first invented an apparatus which multiplied the small electromotive force of a galvanic couple, the column of Volta. The quantity of electricity discharged through a channel is measured by another standard, also very appropriately named after the great French investigator Ampére, who discovered the laws governing the mutual action and reaction of currents of great quantities.

That rarefied air is by no means so good a conductor as assumed by many, is proved by the fact that it requires a considerable electromotive force to pass it through.

I referred in the beginning of this paper to the application of the knowledge recently obtained in regard to the behavior of electricity in rarefied air, and in vacuo for the purpose of explaining certain natural phenomena. These phenomena are principally the aurora borealis and australis, and especially those which are related to the immense enigmas which from time to time appear in the heavens, the comets, which alarm the ignorant.

Of the accompanying two cuts Fig. 1 represents an arrangement similar to the tube exhibited at the lecture, while Fig 2 shows that as direction of the magnetic needle may be deviated by a wire conducting an electric current, *vice versa*, the direction of a flow of an electric current in a partial vacuum will be affected by magnetic influence, as shown by the result of charging and discharging the electric magnet seen suspended over the tube.

CORRESPONDENCE.

New York Notes.

NEW YORK, Dec. 15.—A systematic attack on the work of the Board of Electrical Control is now being carried on through the columns of two of the city evening papers. They were all very anxious for the original enactment of the law, but are apparently surprised to find that the measures adopted for enforcing it are not altogether free from criticism. The charges exacted for the rental of ducts is now receiving attention, and it is claimed that a company is charged $2,850 for rental in a district where its entire patronage amounts to $1,550. The board is apparently indifferent to these attacks, but proceeds calmly with its regular routine business. On Tuesday the Mt. Morris Electric Light company applied for permission to erect a pole line in Harlem, but on account of the report of the expert that the company had failed to comply with the regulations of the board, the matter was again referred to him for a report at the next meeting. A petition of the Ball Electric Light company to string wires in West Broadway, Hudson street and Seventh avenue, was also referred to the expert. Permission was given the Empire & Bay States Telegraph company to string two wires on poles already up, from Woodlawn to Harlem River. The Brush Illuminating company was granted permission to extend its wires overhead through Gansevoort and Greenwich streets, from Gansevoort street to Washington Market.

The case of the Third avenue Railroad company against John Newton as commissioner of public works, was before the Court of Appeals at Albany December 11th. This appeal was in the action for permission to lay a cable conduit for the Third avenue line. John E. Parsons for the company argued that the charter granted the company in 1853 carried with it all the rights of a railroad. When the charter was given there was at least one cable road in existence—that at Schenectady. James C. Carter and D. J. Dean for the respondent and the city, held that the charter conveyed only the rights of railroads existing at that time, excepting that of steam. The charter did not contemplate the building of a masonry trench and vaults beneath the roadway of the street. Mr. Dean held that the right to dig up streets and build these trenches should be purchased under the amended railroad act like all other rights of way. This franchise was too valuable to give away.

The Third avenue road is not having altogether smooth sailing with its 125th street cable line. It narrowly escaped a serious accident a few days ago by the breaking of a strand or something of that nature. As the daily *World* had predicted something of that nature, it is now posing as a prophet in that particular branch of mechanics.

The Brooklyn aldermen at their meeting on December 10th ordered electric lights on the following streets: Montague street, Seventh avenue, from Union street to Twentieth, Lafayette avenue, from Flatbush avenue to Broadway, Willoughby avenue, from Park avenue to Broadway; Wythe avenue, from Flushing avenue to Fourteenth street, and Bushwick avenue, from Gates avenue to Conway street.

The Van Depoele Electric Manufacturing company of Chicago, which now supplies electricity to the Jamaica electric railway, has applied to the Brooklyn aldermen for a franchise for the lighting of the streets of the Twenty-sixth ward in that city.

The Western Union Telegraph company issued on Wednesday this statement of business for the quarter ending December 31st, the earnings for the present month being estimated. The net revenues are set down at $1,650,000, an increase of $150,000 over the corresponding period of last year. There was an increase of $569.188 in the company's surplus at the beginning of the quarter, including the current three months' revenues, aggregate $9,573,757. The quarter's payments for interest and sinking fund amount to $204,802, an increase of $62,152, the quarter's balance being $9,368,955, a gain of $657,036. The quarter's dividend was increased to $1,077,376, the surplus for the quarter remaining $8,291.578, an increase of $657,003. Business incident to the presidential election has much to do with the increase in revenues.

About thirty-five stockholders of the Keely Motor company gathered at Philadelphia on Wednesday, December 12th for the annual meeting, at which it was expected that seven directors would be elected. Most of the stock was represented by proxy, but that was not enough for a quorum. After waiting for over half an hour, there being no prospect of securing a quorum, the meeting was indefinitely postponed. It was intimated that the real reason a quorum was not present was that a number of heavy stockholders of New York failed either to come or send proxies. There were several inquiries for Keely, but the inventor had remained away from the meeting, and was only represented by proxy. P.

Kansas City, Mo.

KANSAS CITY, Mo., Dec. 15.—The American Electric Light company is defendant in a suit for $15,000 damages. Mrs. Dr. Marsh was passing along Main street in the fall when she was struck by a flying rock. She received injuries which, it is alleged, will cause her to be an invalid for life. She charges that the rock which struck her was thrown into the air by a blast conducted by employes of the American Electric Light company, and that the employes and company exhibited gross carelessness. The company's business has been excellent. It has already been compelled to enlarge its plant several times, but its entire capacity is taken up in supplying its patronage, and another enlargement will soon be necessitated.

Work on the Edison building, of the Consolidated Kansas City Electric Light company, is progressing, and is being pushed as rapidly as possible, but the work of all the contractors is delayed. The main trouble is with the iron contractors. They claim that they are not able to get the iron, and, of course, cannot proceed until that necessary part of their work is on hand. Mr. Weeks says that he now hopes that the plant will be in operation by January 1st He asserts it must be in operation by February 12th, when the Edison Electric Light association begins its annual convention in this city. Mr. Weeks expects about 100 delegates to be present, and is confident that the convention will be a grand success. Efforts will be made to have Mr. Edison attend.

C. H Cone, representing the Chicago Electrical Supply company, is in receipt of large quantities of supplies for his ware-room, and will soon have that branch of his business here in active operation.

It is probable that the $100,000 bond proposition of the Kansas City Electric Light company, and the purchase of ground adjoining the Eighth and Santa Fe street plant of the company, should be considered together, and that the money raised by the bonds is to be applied to building an addition that will almost double the capacity of the arc and alternating current plant. Work may not begin before spring. The company has established a reserve incandescent station of about 300 lights at the exposition building.

Superintendent Yenowine, of the St. Joseph, Mo., telephone exchange, was in the city last week.

W. F. Clark of Boston, representing the electric railway construction department of the Thomson-Houston company, who has been traveling over the west with a company of Boston capitalists, returned to this city last week. While in Kearney, Neb., Mr. Clark and others established an electric railway company, which will operate ten cars over its line.

Article of incorporation were filed last week at Topeka, under the Kansas law, for the Kensington Railway company, with an authorized capital of $50,000. The charter is for ninety-nine years, and the stock consists of 500 shares. The motive power may be either steam, cable or electricity, but electricity is to be used if it will prove suitable for the way. The main will be 1½ miles in length. The directors of the new road are Robert Gilham, J. I. Reynolds, W. A. Bunker, M G. Gilham, C. Bullock, D. O Hoagland, W. F Barkhart

A charter has been granted to the Emporia (Kan.) Rapid Transit company. It will probably adopt electricity. The capital stock is $25,000 The directors are H. Parkman, R. R M. Candless, E. E. Smith, S. B. Riggs, C S. Cross, N. E. Weaver and George B. Peters. C.

Wichita, Kan.

WICHITA, Kan., Dec 15.—Another of Wichita's motor lines will adopt the electric system, with a ten-minute service from the Burton Stock Car works. A double plant, two engines and two systems of dynamos will be put in complete, so that if one meets with a mishap the other can be started up.

A communication was read at the last meeting of the council from Houston & Bentley, threatening suit on the part of the telephone company for the amount alleged to be due for the telephone in the city assessor's office used last spring. The council for some time has refused to pay the bill. The bill was produced and called for $62.50. Councilman Healey thought $37.50 would be about the right amount to allow. The matter was finally disposed of by referring it to the finance committee. Judge Sloss was present and asked for a hearing, representing the Citizens' Electric company. Bills had been presented by the company from January 1st to November. The company's bill, according to basis of calculation, is $4,220.57, and the allowance by the city was $1,340, and $2,850 unpaid. The company has been informed that there was a misunderstanding about the contract; the attorney said it would be difficult to determine what was right. But for the last year, before any question of difference arose, the council would certainly be compelled to pay according to the basis of calculation as understood by the company. Up to January the city paid according to company's calculation. The city having paid this could not get any of it back for the future service of the company. For the future the judge read an agreement which the company would enter into with the city, and it provided that a charge of $100 per annum for each light of 2,000 candle power, and to give service each night from dusk to 1 A. M., and double charges for extra service. Deduction would be made for bad service at the rate paid according to contract. The judge said that at the last meeting $1,400 was allowed the company as "payment in full," which, on the terms, would not be accepted. The matter was referred to the gas committee. M.

Kansas City, Kan.

KANSAS CITY, Kan., Dec. 15.—The Kansas City, Mo., Electric Light company has had pole lines in two streets in this city ever since it was established. When the Kansas City, Kan., company began erecting its pole line it invaded these two streets, erecting poles considerably higher than those of the old company, so that there would be no obstructions. No sooner had it got its pole line up than the old company began to replace its old poles with others of the same height as those just set up by the new company. Mr. Friedburg, manager of the new company, saw that if this was done, his lines on those two streets might as well be walled in, and he applied for an order restraining the old company from changing the poles and asking for a permanent injunction, claiming that the old company had no franchise. The restraining order was granted, and the injuction proceedings will be heard shortly. The old company admits that it has no franchise granted by the consolidated city of Kansas City, Kan., but that before the

consolidation took place the individual cities each granted it a franchise, and that it was under these franchises that the pole line was erected. Furthermore, the poles were not raised suddenly for the purpose of annoying or obstructing the new company, but had been under contemplation for sometime, and that the work was done after the new company's pole line was constructed, was merely accidental. The Missouri company's old line was too low; the wires passed through trees, and grounds were frequent and caused many complaints on the part of the company's patrons, and that it was at the request of the latter that the pole line was raised. The old company had intended to let the new company have full sway here, and to make no special effort to retain the patronage it had. But circumstances alter cases, and it may now jump into this territory and contest every foot of ground; that is, if the legal proceedings should end in a victory for the Missouri company.

The contract let by the Metropolitan Street Railway company to the Thomson-Houston Electric company, through its Kansas City, Mo., agency, calls for an overhead construction having a capacity for twenty cars, and the equipment of five cars to begin with, more to be added as the success and patronage of the line shall render necessary. The line is now known as the Armourdale line, and is operated with mule power. It is two and a half miles long. The power station of the road will be located in the Ninth street cable engine house of the Metropolitan company's Fifth street cable line.

When the Kansas & Missouri Telephone company's bill for $95 for telephones in use by the city, came up in the last meeting of the council, Councilman Freeman stated that he understood the city was to have free telephones in consideration of the right allowed the telephone company to erect their poles on the street. The outcome of a discussion on this subject was that City Attorney Carroll was instructed to draw up an ordinance taxing the poles of all telephone and telegraph companies operating in the city.

B.

St. Louis, Mo.

St. Louis, Dec. 15.—W. W. Murray, special inspector in the street department, has submitted to the Municipal assembly a plan for a telegraph and electric light wire pole. The poles are of iron, twelve inches in diameter in the clear at the base, and six inches at the top, seventy feet in height above the street grade, and are joined together by a process of "shrinking" the sections into each other while the metal is at a white-hot heat. Mr. Murray estimates the cost of the poles laid down in St. Louis at $155 each. They can be erected at an estimated cost of from $1,200 to $1,500 a block. He says their employment will obviate the necessity of burying wires.

The Broadway street car line has the poles and iron arches for operating the test of the overhead Short system nearly all erected on the extension from the stables, near the intersection of Seventh street and Broadway, to Broadway and Jefferson avenue. The conducting wires are being rapidly laid, but it is thought it will be impossible to make the first trial this month. It will be made early in January, however.

E.

Indianapolis, Ind.

Indianapolis, Ind , Dec. 15.—The Park theater of this city, which was remodeled last summer, and which until this week used gas and arc electric lights, the latter furnished by the Brush company, has introduced an incandescent system. There are 741 sixteen candle power lamps distributed throughout the different parts of the building. The dynamos, which were furnished by the Jenney Electric company of this city, are located in the Indianapolis *Sentinel* building, the power being furnished by that company. All wires are run direct to a switch-board on the stage, and are arranged in such manner that the stage manager has full control of lights in every part of the auditorium and stage. This is the only theater in the city using incandescent lights, and its introduction makes a wonderful improvement in all respects

A special committee on light was appointed by the city council to hear complaints from residents on North Meridian street of the line of poles recently set on that street by the Brush company by instruction of the council committee on light. After holding two sessions, and no one appearing to enter complaint, the committee decided to report to council that there was no reason for making a change. It is the intention of the Brush company to string heavy rubber-covered wire.

M.

Topeka, Kan.

Topeka, Dec. 15. — Arrangements have been made whereby the track of the rapid transit railway will be constructed to the limits of Potwin Place on Fifth avenue leaving the present line on Clay street. This branch will, probably be constructed during the present week. Nearly twelve miles of ground wire have been laid, and eight miles of poles set. The old motors will soon be disposed of and the entire electrical equipment will be in use in January. The power plant of the road on Jefferson street will be completed in three weeks, and the machinery will arrive in a few days and will be placed in position as fast as possible. The construction of the Second street line from Jefferson street will be completed this week. The road is being equipped by the Thomson-Houston company.

D.

Birmingham, Ala.

Birmingham, Ala., Dec. 15.—The Southern District Telegraph & Electric company of this city has sold to a Florence syndicate an electric light plant for $3,000. This company has also just put in a plant for the Stevens Electric company, which lights the Georgia Pacific and the Alabama Great Southern shops, and the Stevens company's brick works.

An effort is making to create the office of city electrician. The recent fires caused by the improper insulation of electric wires have attracted the attention of insurance men, who will doubtless use their influence in behalf of the movement. The duty of the proposed official will be the general superintendence of the various electric systems, but more particularly to watch the fire alarms and see that they are always in working order. As now proposed, such an officer would work under the instruction of the chief of the fire department.

The Birmingham Gas company is putting in two new dynamos to increase the capacity of its incandescent plant.

A

Des Moines, Ia.

Des Moines, Ia., Dec. 8.—The telephone company has commenced placing the immense cables which will supplant the hundreds of wires which line the business portion of the city.

An ordinance granting to the Des Moines Electric Railway company the right to extend its tracks and electrical equipment on Jefferson street from Sixth to Thirteenth street, was presented at last week's council meeting, and read the first and second times, and laid over under the rules. Judge Baylies was asked what the electric railway expected to do with the right of way on Forest avenue. He replied that while the company was very anxious to secure the Forest avenue right of way, it could not afford at the present time to run on that street. He estimated that it would cost $18,000 to put their line on that street. The electric motors are looked for daily, and when they arrive a week will suffice to put them in the cars and prepare them for use. The track and overhead wires are all in readiness.

John P. Nilson, brother of L. G. Nilson, electrician of the Edison Light company, died Dec. 4. He came from Sweden five months ago, and entered the employ of the Edison company.

K.

Iowa Items.

Oskaloosa, Ia., Dec. 15.—The central plant of the Hawkeye Electrical Manufacturing company has not yet been removed to Davenport, as has been erroneously announced. The delay in removal is caused by the great press of work, but it is thought the change will be accomplished by January 1st.

At Des Moines, the electric railway will soon be in operation. The construction and equipments are pronounced by all visiting electricians to be unexcelled. Four of the cars and the generator were received last week. At a special meeting of town council of North Des Moines, last week, the ordinance granting to the Electric Street Railway company the right of way on Jefferson street west from Sixth to Thirteenth street, was passed by a unanimous vote.

At Ottumwa, the Central Union Telegraph company's new line has been equipped with poles fifty feet in height. The line runs through the alleys. A new switch-board has been put in and altogether, the exchange has become a model one.

F.

Missouri Matters.

Kirksville, Mo., Dec. 15 —By January 1st this city will be illuminated by electricity. The plant consists of seventy-five arc lights of the Ball system. A commodious station of brick has been erected, and all the equipments are first-class. The company is composed of leading citizens, with H. J. Patterson as manager. It is proposed to add an incandescent system to the plant in the spring.

The Chillicothe Electric Light company is adding to its plant. The company has secured the contract for lighting the city.

At Sedalia, the city authorities are searching far and near to find what will be the best and most economical system to adopt for a city electric light plant, which the council has voted to establish.

The Independence (Mo.) electric light company has a city contract for fifteen arc lights.

G.

Omaha, Neb.

Omaha, Neb., Dec. 15.—Dr. Mercer of the Electric Motor line says that the courts will refuse permission to his company to erect poles in the streets when they hold that the franchise granted to his company by a vote of the people is null and void. This statement was called out by the proposition on the part of those opposed to the road to carry their opposition into the courts. The mayor, he said, had asked the city attorney for an opinion on the subject, but the latter had asked for time to examine the question. In the meantime the company has gone quietly ahead, and with hardly any one knowing it has erected forty of its poles. They are painted a dark red color. An ordinance requires the companies using poles to paint their property a distinguishing color.

The Electric Light company, the board of trade, city council and business men of South Omaha, banqueted at the Exchange hotel one evening last week in honor of the advent of electric illumination.

H.

THE ELECTRIC LIGHT.

The Phœnix Electric Light company of Marshall, Tex., has been incorporated.

The cost of lighting the late exhibition at Brussels by electricity averaged about £380 per month.

The Colorado Electric company, of Denver, Col., has recently added a number of Brush arc lamps to its plant.

Several members of the council of Jeffersonville, Ind., are anxious to have the streets illuminated by means of electricity.

It is stated that the Pacific Coast Electrical Storage company has a contract to light Saucelito, Cal., with incandescent lights.

Another Brush incandescent electric light plant has just been placed in the works of the Standard Oil company, at Cleveland, O.

The demand for electric lights in Geneva, N. Y., has lately increased to such an extent as to necessitate the ordering of another 30-light Brush machine and lamps.

The Brush Electric company, Cleveland, O., has recently sold to the Brush Electric Lighting company, of Lafayette, Ind., one 300-light incandescent machine, and one 45 light arc machine.

The city council of Pueblo, Col., has instructed the mayor to offer a reward of $10 for information which will lead to the arrest and conviction of persons destroying electric light globes.

The mayor of Elgin vetoed the action of the city council awarding the contract for electric lights to the Jenney Electric company of Indianapolis, and the council has decided to readvertise for bids.

Carrollton, Mo., will have an incandescent light plant in operation January 1st, under the management of James W. Lacy. It will be conducted in connection with the arc light system recently introduced in that place.

The Brush Electric company, of Cleveland, O., has lately received an order for a machine having a capacity of 30 2,000-candle power lamps, together with a full complement of lamps, to be used for central station lighting in Mexico.

The electric light plant of William McCune & Co., Sterling, Ill., was recently flooded. The Van Depoele dynamo was under water ten days. When it was removed it was supposed to be ruined. It was dried out and then started, and has been running satisfactorily ever since.

The contract for illuminating the city of Pittsburgh has been awarded the East End Electric Light company for $110,592. The contract goes into effect January 1st. It calls for 400 arc and 4,287 incandescent lights. Last year $120,000 worth of oil and gas were burned in public lighting in Pittsburgh.

It is stated that the first set of the 10,000-horse power dynamos and engines in the Deptford central station, London, will be ready in March next to supply current. The London *Electrical Engineer* predicts that 150,000 lamps will be supplied from the station within a year from the time it is ready for work.

The managers of the Monroe county insane asylum at Rochester, N. Y., have petitioned the board of supervisors to grant them an appropriation enabling them to introduce an incandescent light system. Heretofore the institution has been lighted by gas and oil and many times lamps have been overturned by inmates.

The Thomson-Houston company of Chicago recently introduced an incandescent plant, 200 lights, into the Webster, Camp & Lane Machine works at Akron, O. Other recent installations of this company include the following: Mason, Mich., 30 arc lights; Joplin, Mo., 50 arc lights; Burlington, Kan., 30 arc lights.

Commissioner Swift and City-electrician Barrett are engaged in preparing an estimate of the cost for lighting Milwaukee avenue with electricity between North avenue

and Halsted street, Chicago. The surplus in the public-works fund will be used in extending the electric lighting system, if the city council concurs.

A Brussels correspondent writes of an interesting installation at the Northern Railway station in that place. The current is supplied by a storage battery, which is brought charged every evening, and taken away in the daytime to be re-charged. The cells are supported on a specially constructed car, and remain on it during use.

The Brush Electric company, of Cleveland, O., has just received orders from the California Electric Light company, of San Francisco, for three number 8 machines, to increase the capacity of the San Francisco station, and five number 8 machines, with complement of lamps, to be used for central station lighting in Portland, Ore.

The Santa Fe Railroad company contemplates installing a storage battery plant in its new station at Joliet. The Joliet Electric Light & Power company furnishes the light until midnight, but as the station shuts down at that time, and the railroad company does not wish to use gas, it has decided to introduce a plant of the Electrical Accumulator company's batteries and continue the electric lighting from midnight until daylight by this means. The installation will be made under the direction of Alexander Thompson of Chicago, electrician of the Santa Fe company.

The cost of lighting the great exhibition at Paris next year will be one of the largest items of expense. It is estimated that 900 hours of service will be required, and on this basis the following prices have been adopted: For each glow lamp of 16 candle power, 60 fr.; 10 candle power, 45 fr.; for each arc light 500 candle power, 500 fr.; 1,900 candle power 750 fr. The motive power will be furnished at the following rates: Up to 500 horse power hours, 50 cents per horse power hour, and beyond 500 horse power hours, 40 cents per horse power hour. The total illuminating power of electric lamps is estimated at 1,600,000 candles; and the number and types of lamps at present decided upon are as follows: Jablochkoff candles, 124; arc lamps, 1017; glow lamps, 9080; sun lamps, 16.

An electric light plant is being installed in the Town hall at Vienna. The generating plant is divided between two machine rooms at opposite ends of the building. One is already complete, and contains two 60 horse power steam engines driving shunt dynamos capable of supplying 1080 glow lamps of 16 candle power. In the other machine room there will be erected four 100 horse power steam engines and dynamos, collectively capable of developing 60,000 watts. There will also be put up a battery of 320 Khotinsky storage cells, which are to be joined in eight parallels of forty cells each during the charge, and five parallels of sixty-four cells each during the discharge. The total cost of this installation, which will suffice for the supply of current to 5,000 glow lamps, is estimated at £22,000.

A meeting of the committee on underground conduits and conductors of the National Electric Light association, was held at the association headquarters, 16 East Twenty-third street, New York, December 11th. The meeting was called to order by E. T. Lynch, jr., chairman. A preliminary discussion as to the present state of the art was entered into by the members present, and there seemed to be a very general impression that one of the most important things at present was to ascertain more fully and accurately than had heretofore been done, just what has so far been accomplished in this country touching upon the undergrounding of arc light conductors. Several plans for accomplishing this were discussed, and the committee adjourned until December 17th. The members of this committee are E. T. Lynch, jr. chairman; I. M. Davis, F. B. Crocker, Gen. C. H. Barney and Walter C. Kerr.

On the occasion of the bal masque given by I. N. Nickerson at his residence, Cass and Erie streets, Chicago, December 11th, the art gallery was lighted by electric lights, a temporary installation being put in by the Chicago Edison company. The current was furnished by means of storage batteries, which were charged at the central station of the Edison company. The art gallery was most brilliantly illuminated—far more successfully than could have been done by gas, and without the heat and damage to the valuable paintings that the use of the latter would have occasioned. This is, it is asserted, the first time in Chicago that storage batteries have been used for so extensive temporary lighting, light being furnished continuously without flicker, variation or interruption of any kind for over seven hours to thirty-two 16 candle power lamps. The Electrical Accumulator company's batteries were used. The installation was under the charge of Louis A. Ferguson of the Edison company, and Alexander Thompson, electrician of the Sante Fe railroad system.

THE ELECTRIC MOTOR.

The Wave Power company, of San Francisco, has undertaken to utilize the water power of the American River at Folsom in the running of machinery in the manufactories of Sacramento, and dispense with steam power in that city. The water power will be transmitted by electricity over eighteen miles of wire. Work on a dam for this purpose has already been commenced at Folsom.

The St. Joseph, Mo., *Daily Gazette*, in speaking of the electric road in that city, says: "It should be a matter of pride to the citizens of St. Joseph that they are possessed of this electric railway, for, to say nothing of the material benefits accruing to the citizens by the increased service of the road, it is a very large advertising medium for our city. St. Joseph has a reputation abroad as having the first line of successful electric railway in operation in the United States, and Mr. Steinacker says that a great portion of his every-day mail is made up of inquiries regarding the road and its working. Nearly every day some gentlemen are in St. Joseph from some other city to investigate the system, and they come from all quarters of the United States. Yesterday a gentleman from Portland, Ore., was in the city for that purpose, and several days ago one from San Francisco on the same errand." The success of the Union Passenger Street railway has been so great that the management has ordered an additional number of cars, and the Wyatt Park railway of St. Joseph is now being equipped with electric apparatus upon the Sprague system. Eight cars will be equipped.

H. E. Dolan of Toronto has made an interesting estimate of the cost of operating an electrical railroad, basing his calculations upon the St. Catherine, Meriton & Theo bold electrical street railroad, which includes several steep grades and sharp curves. The plant consists of one 100 horse power generator, seven motor cars, and two cars without motors. The main line is about five miles and a quarter, and a branch half a mile Following is an itemized statement of the daily expense: Power station—Power, 83 cents; oil and waste, 20 cents; labor, $3; depreciation on generator at 3 per cent, $1; depreciation on turbine at 10 per cent., $2.70. Road—Oil and waste, $1; brushes, 30 cents; travelers, 30 cents; labor, $2; material for repairs of cars and line, $1.70; depreciation on cars at 15 per cent., $6.30; depreciation on line at 10 per cent., $2. Total, $21.33.

F. B. Trout, general manager of the Woodward Electrical company, last week sold to an eastern traction company 16,348 cells of the Detroit storage battery. The cells are to be supplied as rapidly as the company can manufacture them The cars are to be equipped as fast as the batteries are received. Eighty-four cells will be provided for each car, and a 5-horse power motor will be employed. The motor is placed in the center of each car. The capacity of the cells is 200 ampere-hours each. The cells will be arranged under the car seats, forty-two on each side. Just how often it will be necessary to change the cells cannot be determined at present, as the rates of speed will vary at different points of the line. This order amounts to over $100,000, and the transaction is an enormous one in the storage battery line. The order was only given after a thorough investigation of the battery by the purchaser, which certainly speaks well for the Detroit storage battery. This battery has been but a short time before the public, but as we have before remarked, it is claimed to be a good deal of an advance over anything heretofore attempted, and to be free from some of the objections heretofore found in storage batteries. Since writing the above we have learned that this order has been supplemented by a very heavy one from Milwaukee, the franchise for the state of Wisconsin and Upper Peninsula of Michigan having been passed over to the company on whose account this order was given. The Milwaukee company has a capital of $100,000, and will vigorously push the sale of the battery in its territory. Among those interested in this local company are the Hon. V. B. Cochran of Marquette, Mich.; H. H. Stafford, Milwaukee, Wis.; H. T. West, Milwaukee, Wis., and Mr. Longyear of Marquette, Mich.

In reference to the success of the Julien storage batteries on the Fourth avenue road in New York city, William Bracken, managing director of the Julien Electric Traction company, writes: In a late communication we informed you that we hoped by our new method of regulation to so economize the use of the current from our battery as to make three round trips, or 36 miles with one charge of battery on the Fourth and Madison avenue lines. We have accomplished that result, and our large eighteen-foot cars, carrying unusually heavy loads of passengers, are now making three round trips from Eighty-sixth street to the postoffice and back, 36 miles, without any change of battery. We change the battery but once a day, thus making a great saving in time, When you consider the long steep grades on Madison avenue, and the number of very sharp curves throughout the line, you may imagine how much farther one of our cars will run on a more favorable surface. But we do not intend to end here, as we now hope to be enabled to make a fourth trip or 48 miles on one charge, for the reason that at the end of our third trip we find now the voltage of the battery is still above 2 volts per cell. When the battery is fully charged the voltage stands at about 320 (144 cells). At the end of the third trip the voltage is still 300, and the car acted with as much force and life as it did on its first trip We now go from Eighty-sixth street to the postoffice and back, 12 miles, on an expenditure of less than 15 electrical horse power. Therefore we make the 36 miles on 45 electrical horse power-hours. Calculating the cost to be 2 cents per horse power-hour, you will perceive that it costs but 30 cents for energy for a round trip of 12 miles, or 2½ cents per mile. Assuming 75 miles for a car a day the cost would be $1.87. These data are taken from our books at our electric station. But this is by no means the limit of economy which we hope to reach, for we are now having manufactured a motor far more efficient than those at present in use. Our new cars will be at least two tons lighter than those at present running.

THE TELEPHONE.

E J. Hall, vice-president and general manager of the Bell Telephone company of Buffalo, announces that a New York wire will be run into the office at Rochester, N. Y., connecting the latter city directly with the metropolis. A long distance line is working successfully between New York and Buffalo.

For the last week or two the first submarine telephonic cable has been in working order between Buenos Ayres and Monte Video. The cable runs the length of the bay that separates the Argentine Republic from Uruguay, and it is said is performing its functions better than the terrestrial telephones in that quarter of the world.

The Chattanooga, Tenn, Electrical company is endeavoring to secure a telephone that may be used in the mines, by which cars may be called and other messages transmitted to the miners without calling them out of the mines. The magneto call with manual telephone switch, illustrated in the WESTERN ELECTRICIAN last week, attracted the attention of the Chattanooga company, and will probably be introduced in the Tennessee mines.

THE TELEGRAPH.

A London dispatch says that at a conference of influential Australians and Canadians in that city the question of laying a cable from Vancouver to Australia, touching at Hawaii, Fanning Island, Samoa, Fiji and New Zealand, was discussed, and it was decided to urge the goveroment to support the project.

A decision affecting the rights of property-owners and telegraph companies was rendered December 5th at Columbia City, Ind., by Judge Olds. The suit originated at Fort Wayne and was taken to Columbia City on a change of venue. Judge Olds held that the Western Union company, having accepted the act of congress of July, 1866, the common council of Fort Wayne could not compel the company to remove the poles from Calhoun street, which is a post road, or compel them to put them under ground; that the city having once indicated where the poles were to be placed could not now order their removal, and that the city under its police powers could not pass any ordinance or do any act which would deprive the company of any right given by the act of congress, or abridge any of its rights under the act. He further held that the erection and maintenance of telegraph poles and wires upon the streets are not an additional burden, but is one of the uses for which the street was origioally located The court refused to grant an injunction, dissolved the temporary injunction heretofore granted, and entered a general finding for the telegraph company.

Miscellaneous Notes.

The Electric Smelting company, of Memphis, Tenn., has been incorporated.

A meeting of the New York Electric club was held December 20th. Prof. C. F. Brackett of Princeton college gave the address of the evening.

Mention was made in this column a few weeks ago that works had been established at Montreux for the supply of current for working an electric railway by the overhead system, with continuous currents, between Vevey and Montreux, and for lighting a somewhat extended district by means of alternating currents and transformers. The generators were driven by water power. The works are now disabled. The reservoir at Souzier burst recently and the water coming down the mountain side destroyed eight houses in Souzier, carried away a portion of the carriage road, and also of the railway which runs parallel to it.

In connection with recent experiments to test the fatal character of electric currents, the following dispatch from Cincinnati is interesting: "Chief," the biggest and most vicious elephant in America, has been condemned to death by his owners, the Robinson Brothers. He is about twenty-five years old, weighs 10,000 pounds and is worth over $1 a pound. In 1879 at Charlotte, N. C., he killed his first keeper, John King. Two years later he killed George Sullivan, his second keeper. Many other persons have been maimed or injured by him. It has been suggested that the immense pachyderm be executed by an electric current, and the Robinsons are willing that the experiment be made.

The dispute between King, Brown & Co. of Edinburgh, and the Anglo-American Brush corporation has been brought into the courts for adjustment. The plaintiff in the action, King, Brown & Co., has for some time conducted a considerable business in making and selling electric machinery. The defendant, it is alleged, has threatened the plaintiff with legal proceedings for conducting the manufacture, use, or sale of an invention which is covered by letters patent owned by the defendant, especially that of compound wound dynamos. Plaintiff claims $5,000 damage. The defendant has commenced an action against King, Brown & Co. for infringement of patents. It is charged that on the Orient Steam Navigation company's ships, compound wound dynamo machines are in use which were supplied by King, Brown & Co., and are, it is alleged, an infringement of the Brush company's patent.

The people of Toronto have been agitating the question of compelling the electric light, telegraph and telephone companies to place their wires under ground, but the city solicitor says the city council at present has no power to take such action. He says that the companies to be dealt with will include the Montreal Telegraph company, the G. N. W. Telegraph company, the Canadian Pacific Telegraph company, the Canada Mutual Telegraph company, the Bell Telephone company, and the Toronto Electric Light company. He advises the city council to obtain from the legislature of Ontario the power to compel the Bell Telephone company, the Toronto Electric Light company and other telephone companies to put their wires under ground, but, he adds, it will be necessary to appeal to the parliament of the Dominion for power to compel similar action on the part of the companies whose wires extend beyond the limits of the province of Ontario.

The commissioner of patents at Washington has just rendered a decision supporting Mr. Julien's claim for an inoxydizable alloy as against the claim of the Faure-Selon-Volckmar combination. The Electrical Accumulator company of New York filed an application in the patent office some time ago for a patent, claiming among other things an alloy containing lead and antimony for a support plate in a secondary battery. The patent office thereupon put them in interference with the Julien Electric company. Much expert evidence was offered on both sides. Professor Morton, Mr. Reckenzaun and Mr. Madden testified on behalf of the Electrical Accumulator company, and Professor Barket, Dr. Vander Weyde and Mr. Salom testified on behalf of the Julien Electric company. The case was argued before the commissioner by able counsel on both sides, and the commissioner decided in favor of the Julien Electric company, holding that an alloy of lead and antimony had no novelty, but that an alloy of lead, antimony and mercury, as claimed by Mr. Julien, has specific advantages and novelty. It was proved on behalf of the Julien Electric

company, and it has been admitted by the examiner in his opinion, that while an alloy of lead and antimony has serious disadvantages as a support plate by reason of the crystal line structure of the metal, making it liable to oxydation and consequent disintegration, yet the presence of mercury removes this defect, and makes the alloy homogeneous and practically inoxydizable.

The first of eight tram cars which have been ordered for the Sandhurst-Eaglehawk tramway, Melbourne, has been completed. These cars are required to mount gradients of 5 per cent. at a speed of five miles an hour, the speed on the level being eight miles an hour. The car is provided with two 8 horse nominal motors capable of working up to 14 horse power on the grades. There are 72 storage cells in a car weighing two tons, and the regulation of speed is made by an improved switch, by which the excitation of the field magnets and the connection of the armatures are suit ably varied. The complete weight of the car is 5 tons 10 cwt. and is capable of carrying forty passengers.

At the recent *soiree* of the Royal Society, the principal feature of the evening was the soap bubble experiments of C. V. Boys. One of these afforded a beautiful illustration of the phenomenon of the diffusion of gases. A spherical bubble was blown on to a fixed ring of wire, and within it a smaller free spherical bubble was blown of a mixture of gas and air. This bubble rose and floated near the top of the inclosing bubble, but without coalescing with it, owing to the presence of the intervening layer of air, which prevented actual contact between the two soap films. The whole was then inclosed under a bell glass, to which a current of coal gas was admitted. In a few seconds the inner bubble left the upper part of the larger bubble, and after floating about in it for a short time, descended, and finally rested on the bottom; thus showing that diffusion had taken place through the films, and that the specific gravity of the contents of the bubbles was consequently equalized. This proof of the reality of the diffusion of gases through such a medium as a soap film, which remains intact the while, is a very striking one, and it can be modified in a variety of ways. Thus a soap bubble was blown with pure oxygen gas, and immersed for a few seconds in a bell glass containing the invisible vapor of ether. When the bubble was withdrawn and approached to a flame, it exploded with a flame and report, showing that during the short time of its exposure to the ether vapor, diffusion had occurred, and the original filling of pure oxygen had given place to an explosive mixture of oxygen with the ether.

A new preservative of iron and steel has been found in a modification of the well known Japanese gum lacquer. After many experiments, the preparation has been finally adopted for the imperial Japanese navy. There is a certain difference between the compound prepared for painting iron and steel and the ordinary lacquer employed for wood, but its principal element is still the gum lacquer. The inventor of the new composition had great difficulty in conquering the tendency of this material to get very hard and then to crack, but, according to the reports, he has succeeded at last. Experience has shown that a ship protected with this variety of lacquer has been able to keep afloat in tropical seas for three years—going into dry dock only once instead of six times during that time, as usual. A ship of the Russian Pacific squadron has tried the new coating, and the result has been very satisfactory. It is consequently thought that at last a tolerably perfect anti-corrosive coating for iron and steel structures has been discovered, which may render substantial service in the preservation of all descriptions of erections in these materials. The first cost of the preparation is rather high, but it is claimed that the excess of cost is more than compensated by the protection obtained. For ship use it is also aserted that great advantage accrues from the high polish which this lacquer retains while the coating remains perfect, but on the other hand, fears are expressed that the supply of gum lacquer will be unequal to the demand, if the requirements for these engineering purposes are added to the regular consumption of the article for ornamental joinery and cabinet work.

Personal Paragraphs.

David Chalmers, of the Empire City Electric company, was in Chicago last week.

M. E. Baird, of the Eddy Electric Manufacturing company of Windsor, Conn., was in Chicago last week.

Paul W. Bossart, superintendent of the Inter-State Electric company of Kansas City, was in Chicago recently on business.

John I. Sabin, general manager of the California Electric Works, and Henry D. Stanley, of the Bridgeport Brass company, called at this office last week.

Business Mention.

The Eddy Electric Manufacturing company of Windsor, Conn., has recently opened branch offices in Boston and New York. In Boston the office is in the Hathaway building on Atlantic avenue, and in New York the office is on Broadway.

C. A. Young, director of the Princeton College observatory, in a letter to the Non-Magnetic Watch company, writes: "From my protracted and careful tests of the non-magnetic watch movement you have sent me for trial, I now feel warranted in saying that I find them to be reliable time-keepers of the highest class in every respect. They are not only absolutely insensitive to all magnetic influences, but in the accuracy of their adjustments for temperature and position, and in the steadiness of their rate under varying circumstances, they rival the highest priced chronometers. I can say nothing more emphatic than that if I now had to purchase a watch for my own use, I would unhesitatingly choose one of your movements. Now that electricity is so extensively used, a person even without his knowledge is continually liable to be exposed to magnetic fields of strength sufficient to disturb the running of an ordinary watch very seriously. I regard it, therefore, as hardly less than foolish to purchase a watch of any considerable value that is susceptible to magnetic influences when an equally good and probably superior non-magnetic timekeeper can be had for about the same cost."

The Cowles Electric Smelting and Aluminum company of Lockport, N. Y., has published a pamphlet, entitled "The alloys of aluminum and silicon." In addition to being a clear trade statement, it contains much valuable information regarding the metals of which it treats.

Thomas P. Conant and William Hood, representing the Electrical Accumulator company of New York, have established themselves at Rooms 223 and 225 Phœnix building, Chicago, formerly occupied by the Northwestern Electrical Accumulator company. The business in this territory has passed into their hands.

The C. & C. Motor company has opened a Philadelphia office at 401 Arch street. The company is now in its new quarters in New York, 402 and 404 Greenwich street. The building is a six-story fire-proof structure, which affords excellent facilities for manufacturing. The dynamos and engines are in the basement, and the upper stories contain the machinery, which is run by C. & C. motors. It is one of the most perfect electric power plants in the country.

The business of the Sioux City Foundry & Machine works is rapidly improving, and the prospects for the winter's trade are very flattering. Among their recent sales are two 75 horse power Corliss engines for the *Pioneer Press* building at St. Paul, Minn., and two 75 horse power Corliss engines, to be used for electric light plants, one of which goes to James Bell, David City, Neb., and the other to the Storm Lake Electric Light company, Storm Lake, Ia These consisted of complete steam plants. The first of the new line of sizes, a 10x16 of Giddings' single valve automatic engines, was sold some time since, together with a boiler, to go to the Chillicothe Water, Gas & Electric Light company, Chillicothe, Mo. This will be tested at the works this week and forwarded to its destination at once. They have also a large force of pattern-makers at work bringing out a full line of sizes of this justly popular engine, which is known at the east as the Russell automatic. In addition to this the Sioux City Engine works have recently sold several large boiler plants, together with a number of combined outfits of the Erie Engine works, manufactured by Cleveland & Hardwick of Erie, Pa., for which they are western agents. They are still very busy improving their works, and are putting in at present a 90-inch flywheel lathe; also an overhead traveling crane, 30-foot span and 7 tons' capacity. Their foundry department is driven to its utmost capacity; it has been necessary to work evenings in order to get out the engine work in addition to the large amounts of architectural iron work, which is required by the rapidly-growing country surrounding them. They also report several sales of the Miller duplex steam pumps for boiler feeding. This pump is rapidly growing in favor. During the past two weeks they received quite a number of inquiries for bids on both the Corliss and the high speed type of engines.

Electrical Patents.

Issued December 11, 1888.

394,153. Lamp Hanger. Daniel Chisholm, Utica, N. Y.

394,161. Electric Dispatch Tube. William Dulles, jr., New York, N. Y.

394,164. Electric Contact Maker. James S. Farmer. Salford, County of Lancaster, England.

394,172. Signaling Dynamo-Electric Machine. Elisha Gray, Highland Park, Ill.

The invention consists in the field or exciting electro-magnets, a battery normally in open circuit therewith, a crank or like actuating device for operating the machine, and a circuit controller for governing the circuit of the battery and when actuated by the movement of the crank device to close the same, and thereupon to energize the exciting magnets while the machine is in operation. The invention also consists in the means for automatically reopening the local battery circuit when the machine is not in operation. The invention further consists in a dynamo or magneto electric machine having field magnets and a battery normally in open circuit with said magnets, and an actuating device for revolving the armature of said machine, means operated by the said actuating device for closing the said battery circuit, a shunt or short circuit around the machine, and means for automatically opening said short circuit, while the battery circuit is closed through the said electro-magnets.

The last claim is given: "The combination, with the field magnets, of the armature and means for actuating the same, a local circuit including said field magnets and a circuit-opening device, whereby the local battery circuit is opened when the armature is at rest."

394,173. Ringing-off Device for Telephones. Amenzo Griffith, Springfield, and Henry A. Burbank, Westfield, Mass.

394,180. Cut-Out for Electric Lamps. Charles Heisler, St. Louis, Mo.

The invention is designed to provide electro-magnets and thermal devices which mutually co-operate in assuring the continuity of the line and thereby promote the efficiency of an electric lighting system. The first claim is given: "The combination, in a single device, of a thermal and an electro-magnetic cut-out in operative proximity to each other, the thermal cut-out being brought into operation by the overheating of the coils of the electro-magnet resulting from the imperfect action of the said magnet or its total failure to act."

394,192. Electric Fuse. James Macbeth, Brooklyn, N. Y.

394,195. Bridge for Cutting in New Loops in Telephone Systems. Geo. S. Maxwell, Louisville, Ky.

The first claim reads: "The combination, in a telephone system, of a multiple switch-board, an annunciator, a line wire crossing the said board and supported upon a permanent abutment, a second abutment opposite the first one, a portion of the line wire supported upon the second abutment and connected with the said annunciator, a removable bridge wire connecting the two portions of line wire from abutment to abutment, and a free end projecting from each line wire near each abutment."

394,203. Electro-Magnetic Air-Compressing Rock Drill. Richard G. G. Moldenke, New York, N. Y.

394,207. Electric Underground Conduit. David O. Paige, Detroit, Mich.

394,220. Electric Valve-Operating Device. Frank M. Sparrow, Mattapoisett, Mass.

394,230. Telephone Central Station Apparatus. Theodore N. Vail, Boston, Mass., and John A. Seely, New York, N. Y.

The invention consists in connecting a listening telephone to opposite sides of a pair of united metallic circuits.

The first claim is appended: "The combination of a central station, a series of sub-stations, a series of electrical stations, one for each sub-station, a telephone instrument for each circuit at the sub-station, a telephone in a local circuit at the central station, a series of normally open spring-jacks in said circuit connected in parallel, and a series of jack-plugs, one for each sub-station circuit, for connecting and disconnecting each sub-station circuit with said local circuit in parallel circuit."

394,302. Printing Telegraph. George V. Sheffield, Schenectady, N. Y.

394,307. Thermo Electric Valve Controller. Frank M. Sparrow, Mattapoiset, Mass.

394,332. Electro-Mechanical Movement. Bassett Cadwallader. Chicago, Ill.

The first and last claims read as follows: "1. The combination of a wheel and two independent motors for alternately propelling said wheel in opposite directions through an indefinite number of units of distance, with two electro-magnets arranged to release or check the propelling motors alternately at the end of each unit of distance.

"10. The combination of a bar whose operative end is capable of three motions, two in the same plane and the other substantially perpendicular to said plane, two electromotors for operating the end of said bar in a linear direction and in a second direction at an angle to said first direction, and a third electro-magnet for removing the operative end of said bar from said plane of original motion."

394,380. Wire-Holder for Insulators. Edwin L. Lloyd, Philadelphia, Pa.

394,413. Thermotic Circuit Closer. William H. Soley, Philadelphia, Pa.

394,417. Safety Device for Electric Motors Charles J. Van Depoele, Chicago, Ill.

The invention is intended to interpose between the commutator and field magnet connections and the main terminals of the machine a piece or section of insulating material of less insulating capacity; that is, more easily destroyed or punctured than the insulation upon the wires with which the various parts of the motor are wound. It follows from this construction that on the presence of a dangerous, extra, or other current it will necessarily find outlet through the safety device, destroying the same, but thereby protecting or saving the rest of the machine. An illuminating device is placed in circuit with the safety device, so that when the safety strip has been destroyed the illuminating device will be brought into action, giving notice to the attendant to replace the safety strip.

394,471. Secondary Battery. Louis Duncan, Baltimore, Md.

The invention relates to providing the supporting and conducting base plate or core with a protecting covering impervious to the electrolyte used in the battery, upon which covering the active material is applied. This protecting covering may consist of a hard dense deposit of an oxide of lead.

394,472. Method of Making Secondary Battery Plates. Louis Duncan, Baltimore, Md.

The invention consists in electrically depositing upon the core or supporting plate by means of a very weak current an alkaline solution of a salt of lead, and at the same time agitating the solution.

394,473. Method of Making Secondary Battery Plates. Louis Duncan, Baltimore, Md.

The invention consists in first applying to the core or supporting plate an impervious coating of material, and then depositing thereon from an alkaline solution of a salt of lead, and at the same time heating the solution.

394,474. Secondary Battery. Louis Duncan, Baltimore, Md.

The 8th claim is given: "In a secondary battery element the combination of a plate of conducting material other than lead, a layer of lead, a hard dense layer of an oxide of lead, and an external layer of loose or porous peroxide of lead."

394,485. Electro-Magnetic Switch. William W. Griscom, Haverford College, Pa.

394,491. Electric Alarm and Water Gauge. John H. Johns, National Military Home, Kan.

394,525. Safety Device and Signal for Electric Motors or Generators. Charles J. Van Depoele, Chicago, Ill.

394,541. Electric Distribution by Secondary Batteries. Zach Latshaw, McKeesport, Pa.

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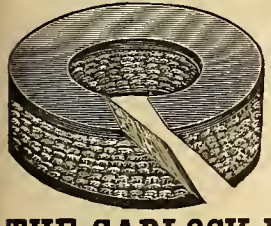

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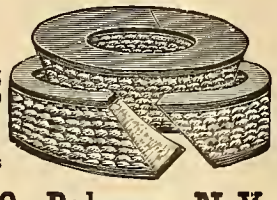

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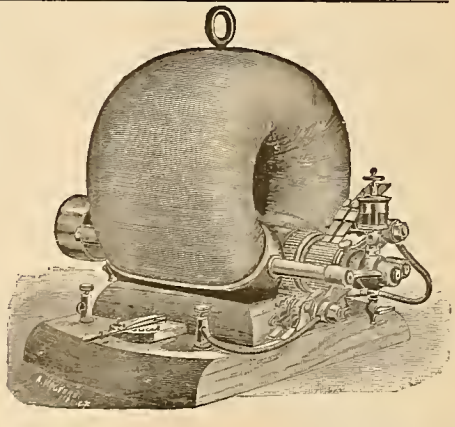

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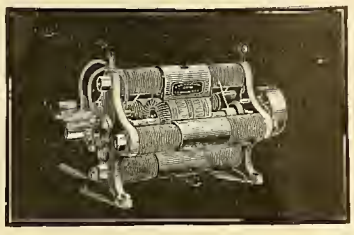

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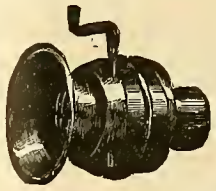

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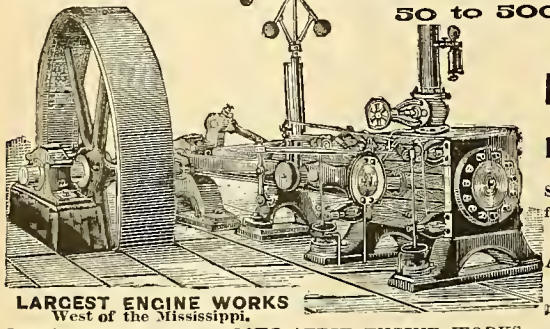

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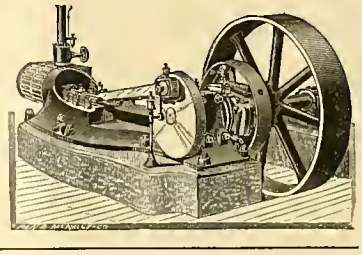

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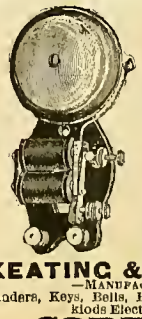

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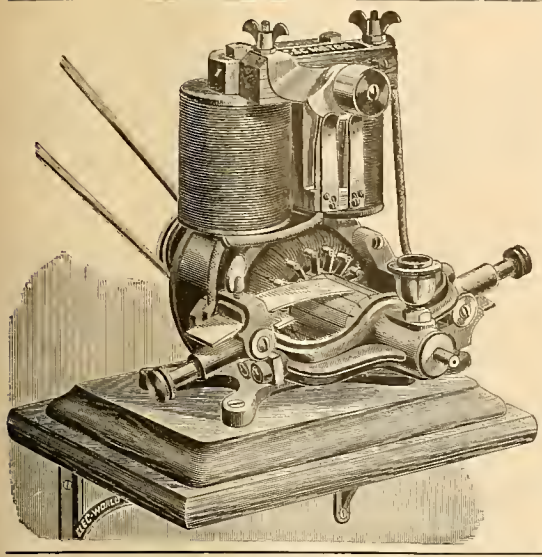

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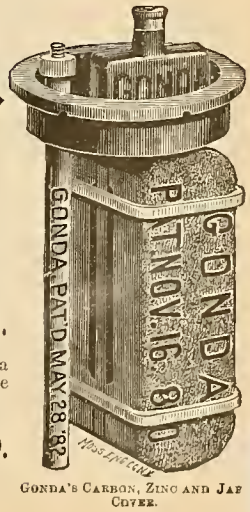

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Is too long to publish *in extenso* as an Advertisement. Orders were received on eighteen working days, the five heaviest days yielding respectively, 16, 11, 10, 8, and 7 ENGINES EACH.

TOTAL, 86 ENGINES, AGGREGATING 3310 H. P.

Sales for August, September and October were over 200 ENGINES of all types, aggregating nearly *10,000 HORSE POWER*. Note in connection with the above exhibit, that our current advertising expenses for 1888 are about one-half that of any preceding year.

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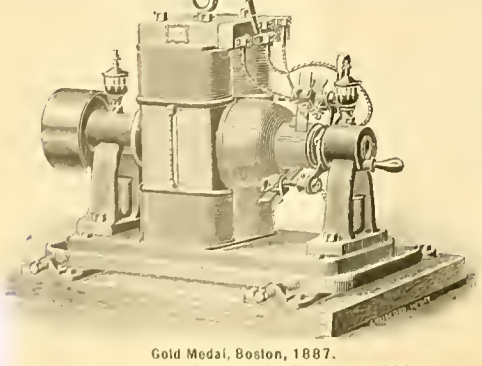

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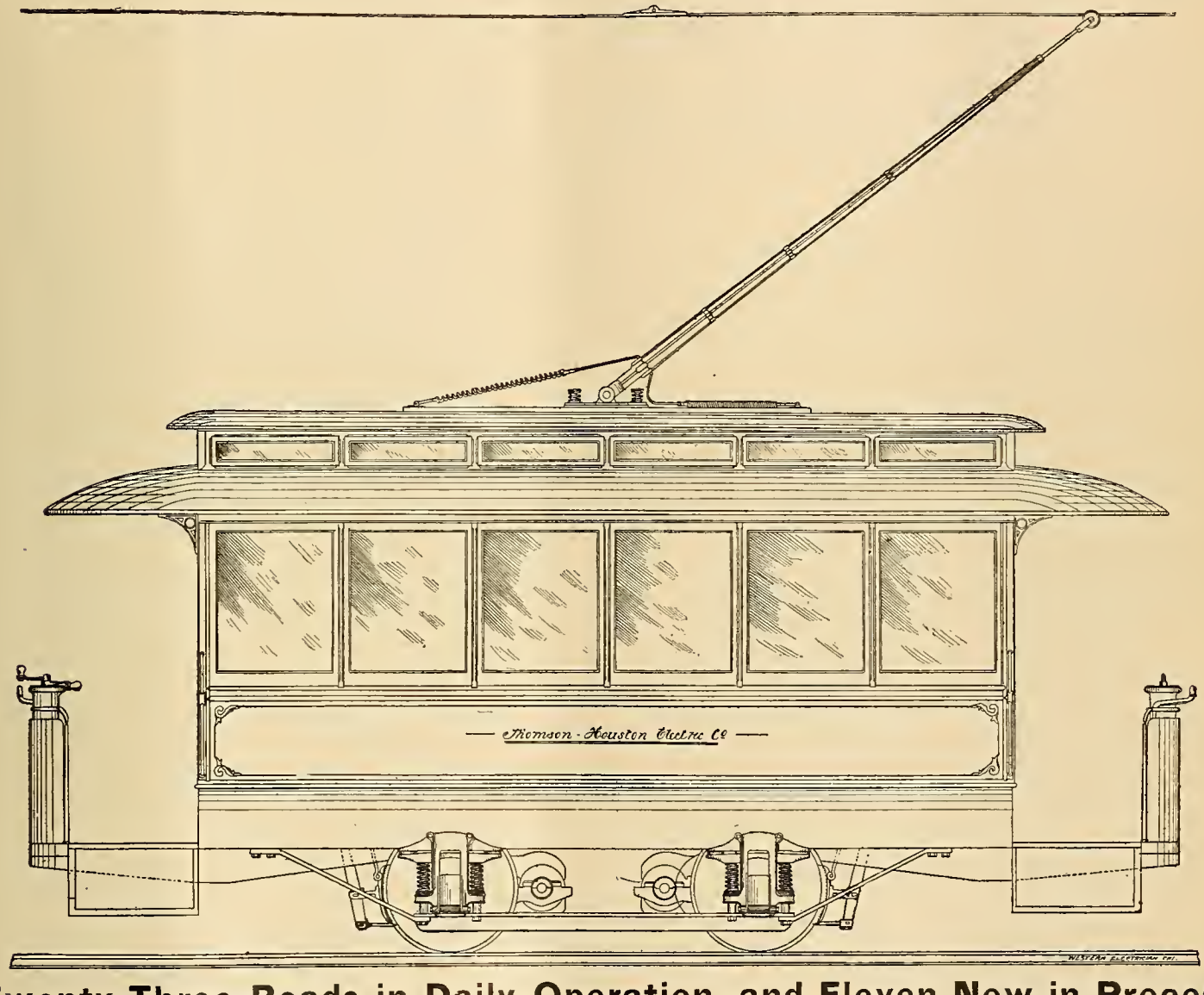

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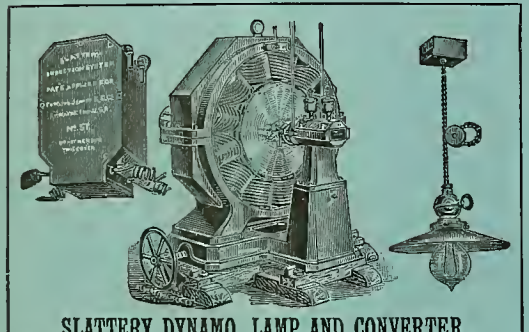

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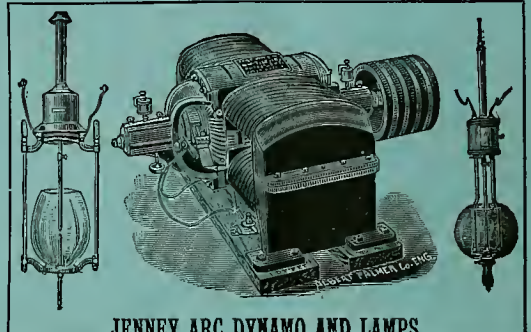

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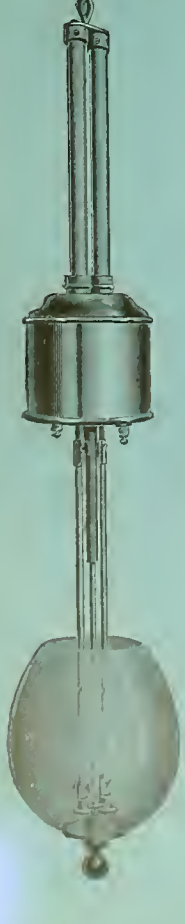

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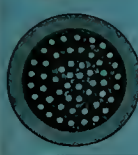

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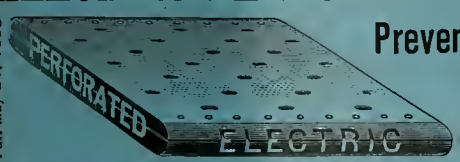

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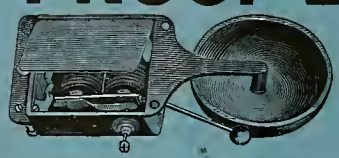
Superior to  All Others.

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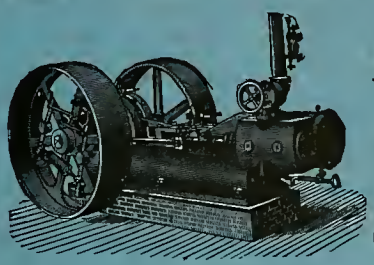

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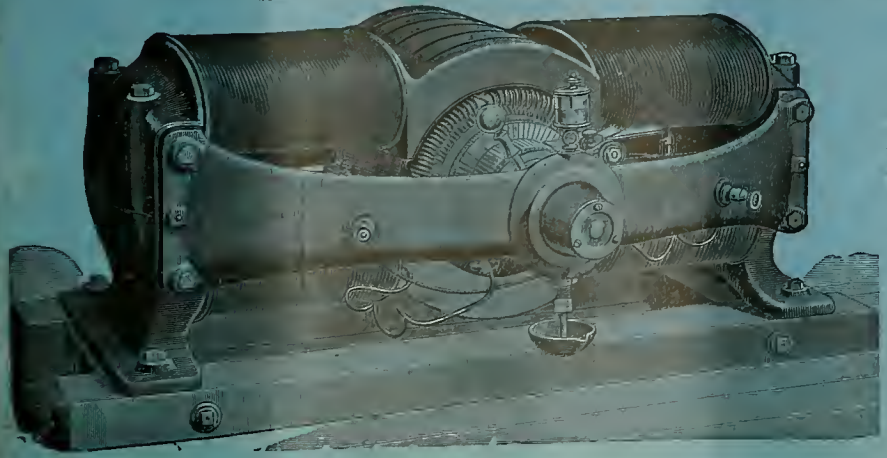

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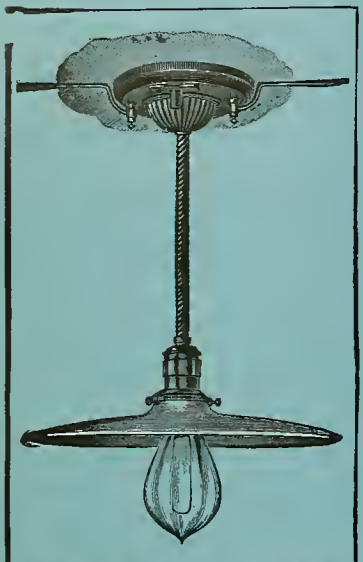

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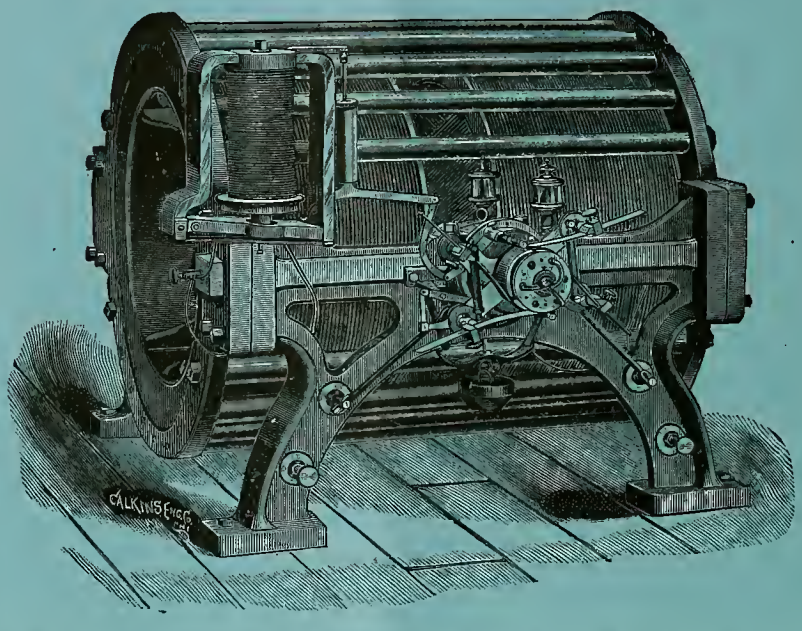

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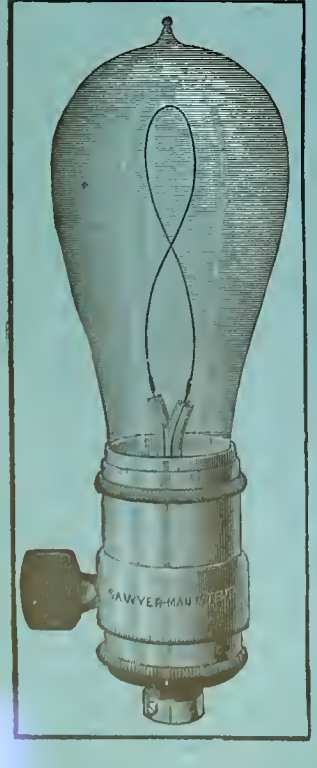

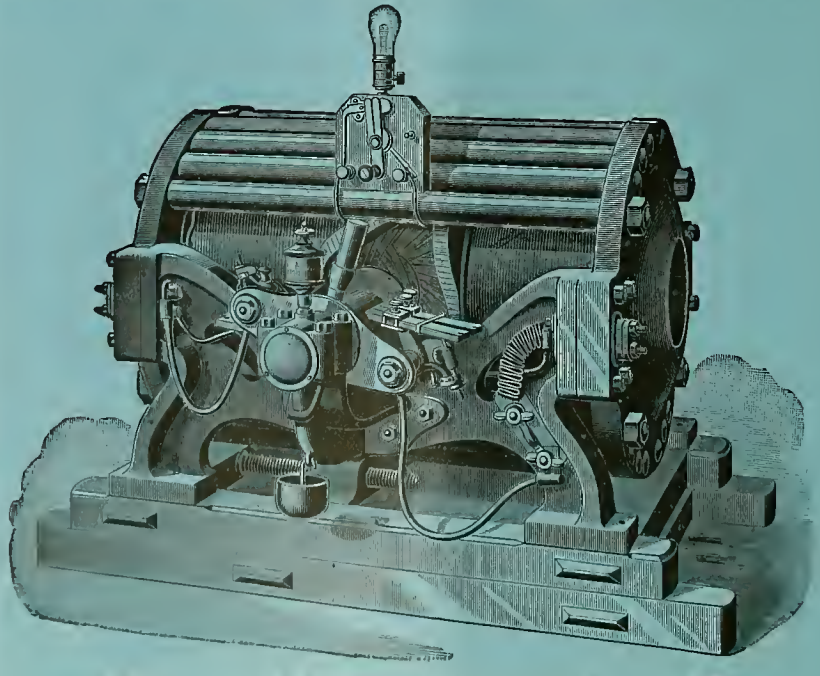

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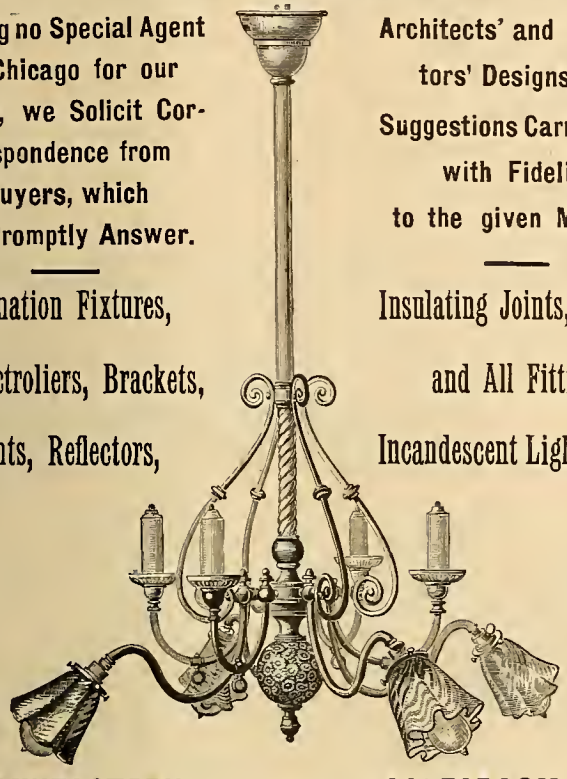

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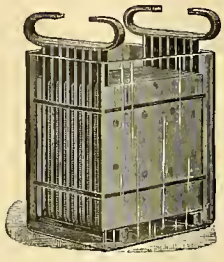

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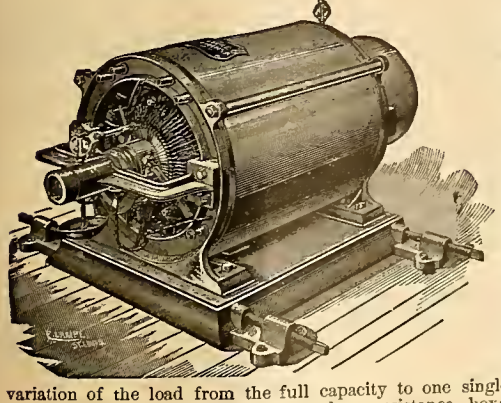

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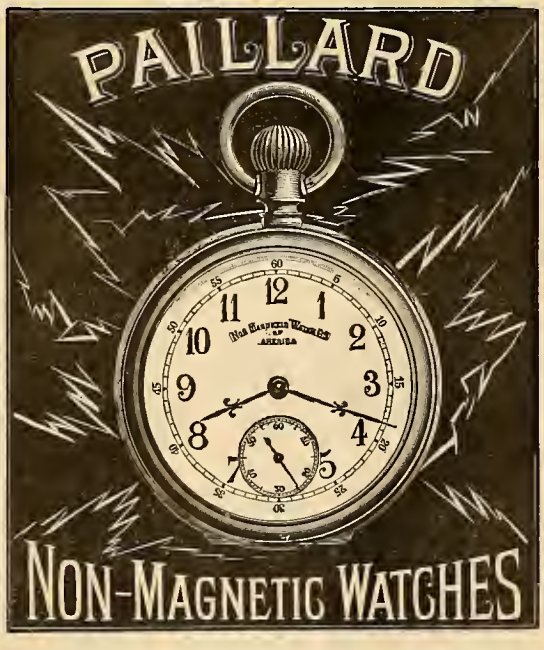

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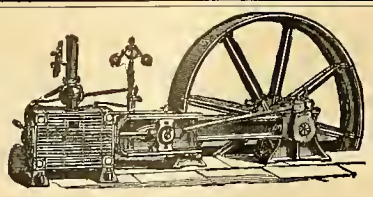

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The Edison Direct System of Central Station
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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

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THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF
THOMAS ALVA EDISON.
Which Patents absolutely control this The Only Permanently Established and Commercially Successful
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As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

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Note the sale of 132 Central Station Plants by this Company, aggregating a total generating capacity of 240,000 16-candle-power lamps, within the brief period of twenty-four months, together with the fact that out of these 132 Central Stations, 38 have increased their plant since starting.

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By reason of an improvement in the manufacture of Lamps which has been secured for the exclusive benefit of the users of apparatus furnished by the Westinghouse Electric Company, this Company will guarantee from its Apparatus and Lamps 50 per cent. more light from a given expenditure of power (fuel) than can be obtained with any direct current system.

ALTERNATING CURRENT METERS.

This Company's Meter measures the whole current by a positive mechanical movement.

It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

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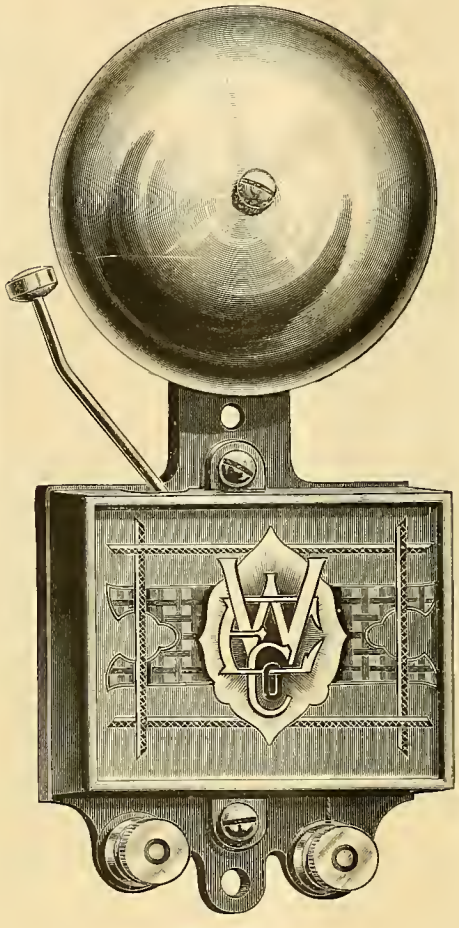

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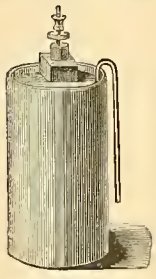

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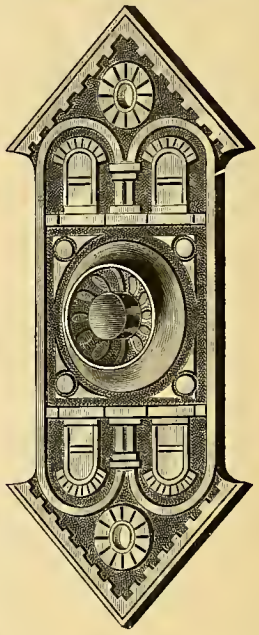

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WESTERN ELECTRIC COMPANY,

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Western Electrician.

EVERY SATURDAY.

Vol. III. CHICAGO, DECEMBER 29, 1888. No. 26

The Detroit Storage Battery.

So many are the possible applications of a successful secondary battery that there is no question more interesting to electricians to-day than the satisfactory solution of the storage battery problem. The storage battery of the future will play an important part in connection with street railways, central and isolated lighting, boat propulsion, signal bells, small motors for driving sewing machines, ventilating fans, and numberless other purposes. Hundreds of thousands of dollars have been spent on storage battery experimental work, and genuine progress has been made in the right direction, and the batteries are now in daily use on a limited scale for many of the purposes mentioned above.

The Detroit storage battery, illustrated herewith, and manufacured by the Woodward Electrical company of Detroit, Mich., is a new candidate for popular favor, which certainly possesses many distinctive and valuable features.

At first sight the battery does not seem to differ much from other storage batteries, but on close investigation it is found that the surfaces of the lead plates present a very peculiar appearance. These plates are made in the following way, which, as will be seen, is entirely different from any process by which plates for other storage batteries are made: A mould of the requisite size —say ten inches high, ten inches wide, and ten inches long—is filled with large crystals of common salt. Molten lead is then poured in the mould. The metal will, of course, readily penetrate the spaces between the crystals, which are embedded in the molten mass.

When the mass cools it is sawed into disks of the desired thickness, and the plates are placed in water to dissolve the salt. When this has been accomplished the plates are full of irregular cavities of the form of the salt crystals. This appearance of the surface of the plate is excellently shown in Fig. 3 which is actual size.

The active matter, oxide of lead, commonly known as red lead or minium, is put into the cavities. It will be readily seen that, as the irregular spaces which had been occupied by the salt are larger inside than outside, the active material cannot drop out. These plates are formed and connected in the usual way, and the positive and negative electrodes are insulated from each other by hard rubber dividers in the shape of corrugated forks, as illustrated in Fig. 2. The closed end of the fork is put at the bottom; thus each plate is independently supported by two of these forks. The claim is made that these plates are particularly adapted for traction purposes for the following reasons:

First.—The plates possess great solidity, which enables the cell to withstand the hard usage it is liable to encounter in working railroads and street cars.

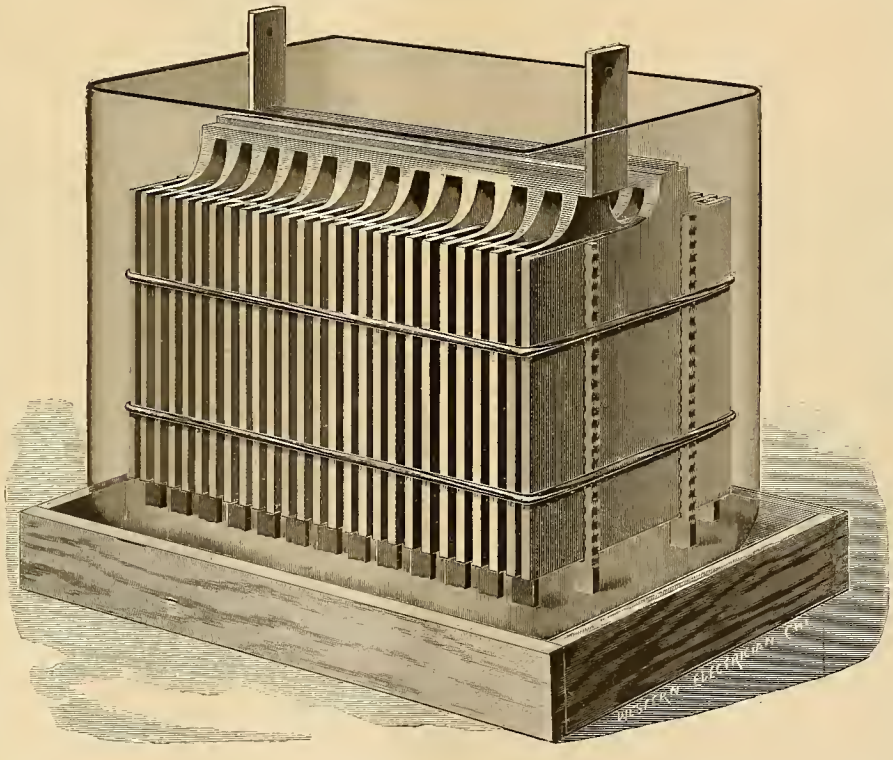
Second.—The positive plates do not buckle.

Third.—The plates are constructed of porous lead; the pores are filled with the active material, and, being of a wedge-shape form, it is quite impossible for the parts to be shaken out by the vibration or jolting of the car.

Fourth.—These cells will withstand high rates of discharge, which is necessary in starting cars or ascending steep grades.

The cells are made in six different sizes, as indicated in the following table:

Type.	Working Rate in Amperes.		Capacity, in Ampere-Hours.	External Dimensions in Inches.			Weight Complete in Pounds.
	Charge.	Discharge.		Height.	Width.	Length.	
25 M.	35–45	1–45	400	11½	9½	15½	140
21 M.	25–35	1–35	310	11½	9½	13	125
15 M.	16–25	1–25	240	11½	9½	9	80
21 P.	16–20	1–20	175	8½	7	13	68
17 P.	10–16	1–16	147	8½	7	10½	52
11 P.	6–10	1–10	90	8½	7	7½	34



DETROIT STORAGE BATTERY.

Two interesting installations have recently been made with these batteries, which are illustrated herewith. Fig. 4 gives a view of the installation at Prof. Elisha Gray's laboratory at Highland Park. The current is utilized in lighting Prof. Gray's residence, and for experimental purposes.

Fig. 5 illustrates an installation at the factory of the Western Electric company, Chicago. The current is employed in supplying a number of 50 volt incandescent lamps in the offices at times when the workshops and engines are shut down.

The Detroit battery has been very favorably received, and a large number of cells have already been put upon the market, one order of no less than sixteen thousand cells having been booked from an eastern traction company, as has already been mentioned in these columns. The Woodward company is a solid and enterprising concern, and the battery will be vigorously pushed to the front.

Opposed to West Side Cable Road.

Residents of the west side of Chicago will be interested in reading of the mishaps of the cable system on the north side, in view of the probability of the introduction of the system on the west side. The opposition to the cable system is becoming more pronounced every day, and reports of broken cables and blockades on the north side do not have a tendency to reassure west siders. According to the Chicago *News* of December 19th, a train of three cars was left standing, at 1:30 P. M., on the curve at Randolph street, almost completely obstructing traffic: "After the most of the passengers had left the car for horse cars, thereby paying two fares into the coffers of the north side street car railroad trust, the strand began to twist its sides and lope along like a snake with a broken back."

The *Tribune* records a similar incident the same day. It says: "The north side street car system struck its first taste of winter mishaps yesterday. Shortly after 5 o'clock last evening Clark street grip car No. 424 on its journey south through the tunnel came to a full stop. Expostulations and harsher language from the be-tunneled passengers failed to move the obstinate grip, while in the meantime the string of cars in all directions, north and south, grew longer and longer. When the blockade was complete around the inner loop, and far enough on Clark and Wells streets to block horse car traffic, the broken grip was started, and for the next hour a string of cars were chasing each other round the loop and up north, regardless of passengers, in their anxiety to make up the half hour lost in the tunnel. Such of the 6 o'clock passengers as were not able to vault into a flying car were forced to walk. In order to even up things a horse car on State street about the same hour struck a snag and maintained the reputation of the aristocratic branch of the north side car lines for obstinacy equal to that of the cabled tracks. Passengers were patient as usual."

It is not to be wondered, in view of these facts, that the residents of the west side do not favor the introduction of the cable system. The demand for electrical railways is growing, and despite Mr. Yerkes' statement that he does not believe them practicable, the fact that they are successfully operated in other cities suggests to the minds of west siders the query: Why can't they be operated in Chicago?

The efficiency of the electric search-light apparatus, as supplied to British war vessels, was recently exemplified in the Bombay Harbor by the gunboat "Mariner," which arrived there from the Seychelles. The night was dark, but the vessel was able to steam in to a point opposite the Apollo Bunder, where she made fast to an Admiralty buoy. The flashes thrown out by the apparatus rendered Malabar Hill and the whole coast line distinctly visible from Colaba.

St. Louis Telephone Company Victorious over the Municipal Assembly.

The decision of the Missouri Supreme court in the case of the city of St. Louis against the Bell Telephone company of that city will be found below. It is a decision of the highest interest to every telephone company in the United States. The history of the case is briefly as follows: The Bell Telephone company had fixed a scale of prices for the use of instruments in St. Louis. Under the scale that rates were: $60 per annum for dwellings, $80 for physicians, $100 for business houses and $120 for public stations. The Municipal Assembly of St. Louis passed an ordinance providing that the annual charge for the use of a telephone in the city should not exceed the sum of $50. The penalty for violation of the ordinance was a fine of from $50 to $500.

The company denied the right of the assembly to adjust its rates. The company proposed to collect $120 from a St. Louis liveryman, and this was selected as a test case. The company was prosecuted in the police court, and a decision against the company was the result. The case was appealed and a second decision against the company was obtained. The controversy was carried to the Supreme court of Missouri, which has just given a decision sustaining the position of the telephone company. The opinion was written by Judge Black, and the full text is as follows:

"This was a prosecution against the Bell Telephone company of Missouri for the violation of an ordinance which provides that 'the annual charge for the use of the telephone in the city of St. Louis shall not exceed $50.'

"A violation of the ordinance is made a misdemeanor, and subjects the offender to a fine of not less than $50, nor more than $500. The defendant appealed from a judgment assessing a fine of $300 against it. The defendant is a corporation organized under Article 5 of Chapter 21 of the Revised Statutes of this state, and hence has all the power therein conferred upon such corporations. Among others they have the power to own and operate lines of telephone, to make such reasonable charges for the use of the same as they may establish, to erect their poles along the cross public roads and streets, to condemn private property for a right of way, and they are charged with the duty of receiving and transmitting messages with impartiality and good faith. The defendant neither affirms nor denies the power of the state itself to fix a maximum rate of charges, but does contend that no such power has been delegated to the city of St. Louis. The defendant's property, consisting of poles, wires, fixtures and the like, is of course, private property; but the property is devoted to public use, and since the defendant has conferred upon it special franchises and privileges, including the right of eminent domain, the corporation is subject to public regulations; and we shall take it for granted that the state has the power to fix and prescribe a maximum rate for telephone service. That this power could be delegated to municipal corporations is equally clear. The ordinances of the city of St. Louis must not be in conflict with the general laws of the state. If the city has had this power to fix rates conferred upon it, then an ordinance which fixes reasonable maximum rates would not be in conflict with the law under and by virtue of which the defendant is organized, and which law constitutes its charter.

"A telephone company, when once its poles are planted and wires stretched on or over the streets of a city, becomes in effect a monopoly, and the company must submit to such reasonable regulations as the municipal corporation has power to prescribe. The important question, then, is whether the city of St. Louis has the power to enact the ordinance in question, the power to fix reasonable maximum charges for telephone service, and nothing to the contrary being shown in this case, it is assumed that the rate fixed is reasonable, so that the question is narrowed down to one of power on the part of the city to fix telephone rates at all. If the city has such power it must be found in a reasonable and fair construction of its charter. Judge Dillon makes this full and comprehensive statement of the rule as to municipal powers: It is a general and undisputed proposition of law that a municipal corporation possess and can exercise the following powers and no others: (1) Those granted in express words. (2) Those necessarily or fairly implied in or incident to the powers expressly granted. (3) Those essential to the declared objects and purposes of the corporation—not simply convenient, but indispensable. Any fair, reasonable doubt concerning the existence of power is resolved by the courts against the corporation, and the power

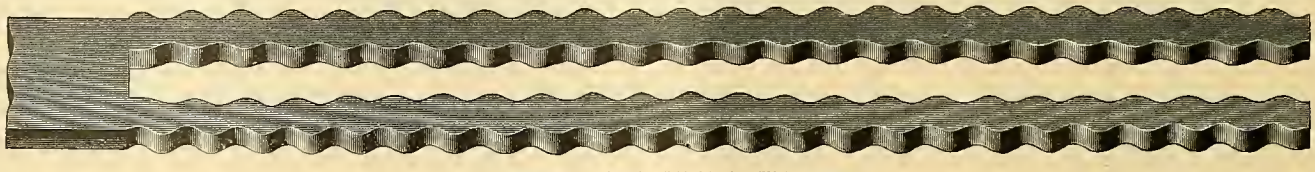


FIG. 2. DETROIT STORAGE BATTERY—THE DIVIDER.

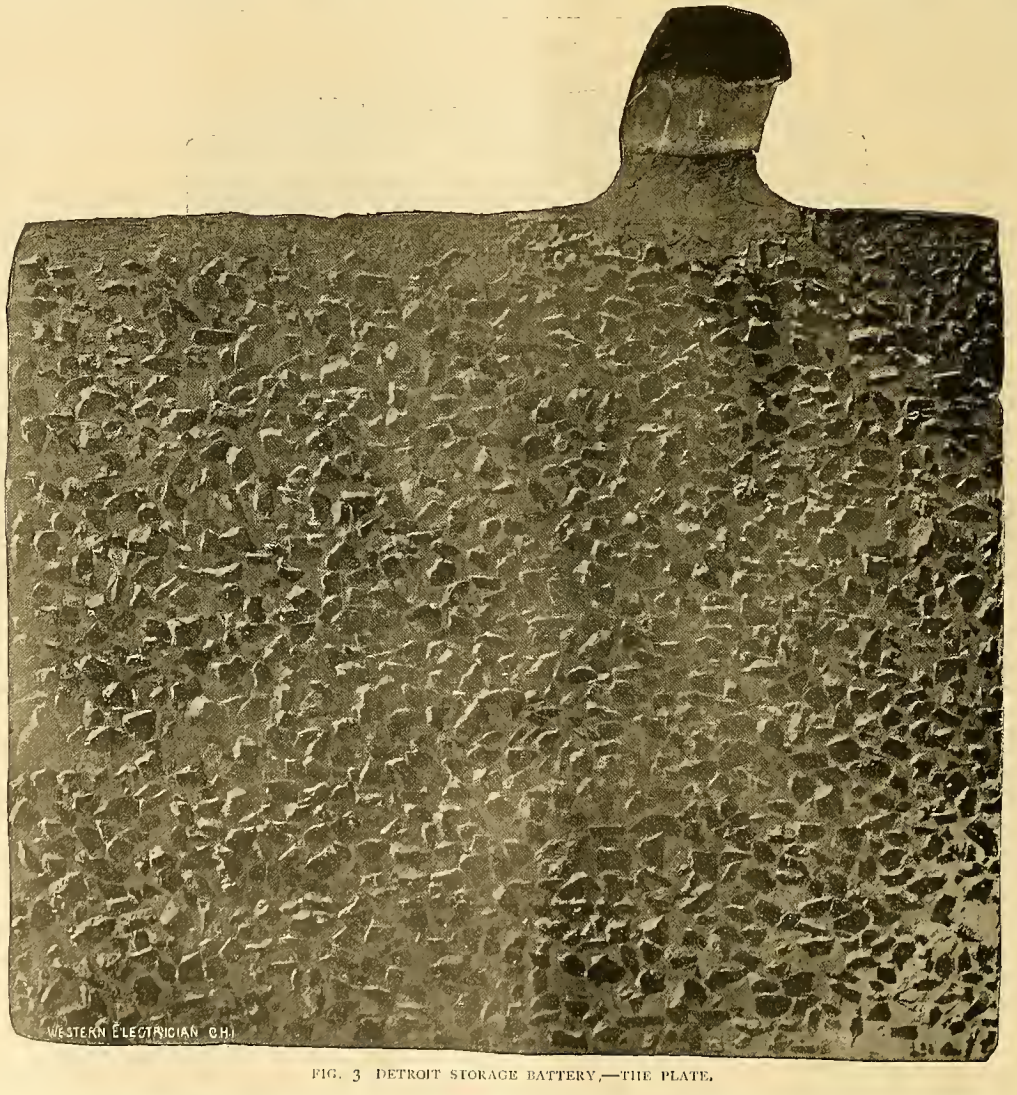


FIG. 3 DETROIT STORAGE BATTERY,—THE PLATE.

is denied. [1 Dillon Municipal Corporations, 3d ed., sec. 89; see also St. Louis *vs.* McLoughlin, 49 Mo., 562.] The rule, as before stated, is in accord with what we said in the city of St. Louis *vs.* Herthel, 88 Mo., 128. The city places some reliance on its general power to regulate the use of streets. This power extends to new uses as they spring into existence from time to time, as well as to uses common and known at the time of the dedication or grant of the power to the municipal corporation. [Ferrenbach *vs.* Turner, 86 Mo., 416.] The erection and maintenance of telephone poles is one of new uses; such use is a proper use of the streets. [Julia Building association *vs.* Bell Telephone company, 88 Mo., 258.] That the company is subject to reasonable regulations prescribed by the city, as to planting its poles and stringing its wires and the like, is obvious. Such regulations have been obeyed by this defendant. Conceding all this we are at a loss to see what this power to regulate the use of the streets has to do with the power to fix telephone charges. The power to regulate the charges for telephone service is in the words of the general concluding clause.

"It can make no sort of difference that these telephone companies were not in existence at the date of the charter. One of the objects had in view by the use of the general clause was to provide for just such cases. As aptly observed in that case, 'we are to construe it (the charter) according to the intent of the framers, and that intent must be gathered from the language and object of the charter provisions, and giving that language an interpretation neither strict nor strained.' Does then, the power to regulate telephone companies, when that term is coupled with the powers to license and tax, give the city the power to regulate the charges for telephone service? By the general statutes of Massachusetts of 1860, page 167, it is provided that the mayor and aldermen of any city may make rules and orders for the regulations of carriages, and may receive $1 annually for each license granted to a person to use a carriage in the city. Under this power it was held, in Commonwealth *vs.* Gage, 114 Mass., 328, that a city sufficient to give the power to fix rates and charges. The power to regulate, it may be conceded, gives the city the right to make police regulations as to the mode in which the designated employment shall be exercised. [1 Dillon on Municipal Corporations, sec. 358.] But taking these charter provisions together, we think it would be going to an extreme length to say that they confer upon the city the power to fix telephone rates. If it has power to do this, it may also fix the charges for telegraph services and for the other designated services which are of a public character. We conclude that the city has no power to pass the ordinances in question by reason of any of the charter powers before considered. This brings in the general welfare clause, which is in these words: 'Finally, to pass all such ordinances, not inconsistent with the provisions of this charter or the laws of the state, as may be expedient, in maintaining the peace, good government, health and welfare of the city, its trade, commerce and manufactures, and to enforce the same by fines,' etc. Sometimes the

FIG 4. DETROIT STORAGE BATTERY.—INSTALLATION AT PROF. ELISHA GRAY'S LABORATORY.

neither included in nor incidental to, the power to regulate the use of streets, and the ordinance cannot be upheld on any such ground. By the Fifth subdivision of Section 26, Article 3 of the charter of St. Louis, the mayor and assembly have power 'to license, tax and regulate lawyers, doctors, etc., etc., telegraph companies as corporations, etc., etc., and all other business, trades, avocations or professions whatever.' Telephone companies are not mentioned, though a vast number of trades, professions and avocations are specified. They are not mentioned in all probability because not existing at the date of the charter. In construing this paragraph of the charter, we held in the case of City of St. Louis *vs.* Herthel, *supra*, that architects were, for purposes of construction, *ejusdem generis* with lawyers, doctors, dentists and artists, and therefore included by the general concluding words. So in this case it may, with equal propriety, be said that telephone companies are *ejusdem generis* with telegraph companies, and therefore included might fix the compensation to be charged by hackney coachmen. This case would at first seem to furnish some authority for the claim made by the city in this case. Turning to other provisions of the charter we find that express power is given to establish ferry rates; to fix the rates for carriage of persons, and of wagonage, drayage and cartage of property; to regulate the price of gas, and to regulate and control railways within the city as to their fares, hours, and frequency of trips. These express powers to fix prices, fares and charges, in these specified cases, are followed by no general words. With this specific enumeration of cases where the city may regulate the compensation to be charged, it impliedly appears that such a power was not intended to be given in other cases. This conclusion presents itself with more force when we see that by the clause before quoted the city has power to license, tax and regulate private carriages, omnibuses, carts, drays and other vehicles; so that the framers of the charter did not regard the power to license, tax and regulate power to enact ordinances is given in general terms, and in other cases there is a specfic enumeration of the powers. This difference, says Dillon, 'is essential to be observed, for the power which the corporation would possess under what may be termed the welfare clause, if it stood alone, may be qualified, or when such intent is manifest, impliedly take away by provisions specifying the particular purposes for which by-laws may be made.' [1 Dillon, Municipal Corporations, 3d ed., sec. 315.] Under a general power like the one now in question this court has held that the city may pass ordinances concerning vagrants, prohibiting persons from keeping open their places of business on Sunday and prohibiting cruelty to dumb animals. [St. Louis *vs.* Schoenbush, 95 Mo., 618, and cases cited.] These matters are all within police regulations, strictly speaking, and naturally fall within the domain of municipal legislation and regulation. To say that under this general power the city may fix rates for telephone services would be going entirely too far. This con-

clusion is manifest when we consider that the charter points out with particularity those cases in which the city may fix rates and charges. What has been said in respect of the power to license, tax and regulate, applies with equal force here. We are not cited to, nor have we found any adjudicated case which will support the ordinance now under consideration under the present charter powers of the city of St. Louis. The judgment in this case is therefore reversed. Ray, Judge, absent. The other judges concur."

The decision naturally awakened considerable interest in Chicago. The telephone people rejoiced, as they looked upon it as a point in their favor in the controversy with the council. Corporation-counsel Green evidently felt relieved, as the decision strengthened the position he had assumed, that the council had no authority to regulate the telephone rates. On the other hand, the aldermen and citizens who have been fighting the company claim that the decision in St. Louis does not discourage them, and they propose to continue the fight. They assert that they will appeal to the legislature for the enactment of a law vesting the city council with the desired authority. On this point representatives of the telephone company point to the situation in Indiana, and say they will pursue a similar course here. Should the legislature interfere they can immediately close operations and throw up their franchise. This policy was pursued in Indiana, and the Cushman company entered the field, but was driven out by the courts, and after January 1st there will be no telephone service in that state. It is hardly possible, however, that the company will be obliged to assume such a course, as there is a strong sentiment among representative business men favoring a compromise. The company will undoubtedly be ready to listen to any reasonable proposition at any time.

Many of those interested in the agitation favored introducing an ordinance in the council with the provisions agreed upon by the finance committee. This ordinance provides: (1) For the payment to the city of 3 per cent. of the company's gross earnings; (2) to supply the city with free service; (3) to give telephone sets for the police and fire alarm system at $5. The city reserves the right to tax telephones if the power is conferred on it by law. The provision of the ordinance on this point is:

"Provided, however, that nothing in this ordinance contained shall be construed or taken as preventing the city of Chicago, whenever it shall be authorized so to do, from passing an ordinance regulating the rates to be charged by telephone companies for the rental of telephones, or for the licensing of telephone companies, it being the intention of this ordinance that the city of Chicago shall in no way surrender any rights that it may have, or may hereafter acquire, to license telephone companies or to regulate the prices to be charged for telephones.

Those who favor a moderate course say that the company can scarcely be expected to accept such a proposition, in view of the fact that the city is practically without ground upon which to make a contest.

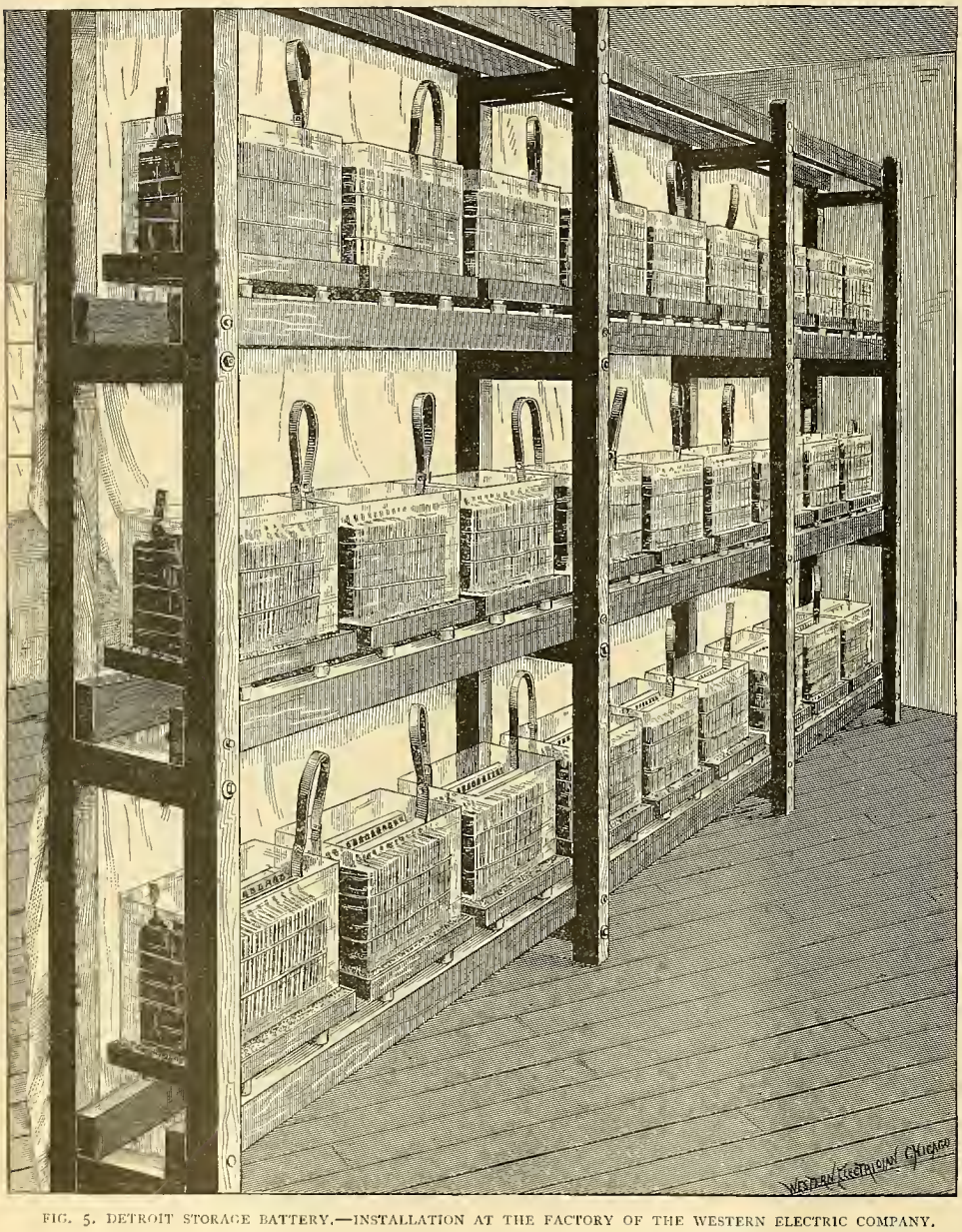


FIG. 5. DETROIT STORAGE BATTERY.—INSTALLATION AT THE FACTORY OF THE WESTERN ELECTRIC COMPANY.

The city council of Council Bluffs has under consideration a proposition made by representatives of the Brush Electric Light company of Cleveland to furnish incandescent light of 16 candle power at 70 cents per month, in consideration of the privilege of placing poles and wires in the streets.

Van Depoele Incandescent System.

An incandescent system has recently been put on the market by the Van Depoele Electric Manufacturing company of Chicago. The distinctive features of the system are illustrated in the accompanying cuts. The manufacturers claim that the Mayo dynamo, as the machine is called, is simple, compact, durable and easily managed. The dynamo is automatic in its regulation, and tests have demonstrated its ability to work perfectly under the greatest changes of load. The resistance of the armature is low, and the efficiency of the machine is therefore high. The adjustment of the commutator brushes is simple and easy, and the commutator itself is large and has ample surface, so that sparking is nearly eliminated. The segments are insulated with mica, so that short circuits are nearly impossible.

FIG. 1. VAN DEPOELE INCANDESCENT SYSTEM.—DOUBLE POLE SWITCH.

The shafts are of high grade steel, of ample size, and are run in long bearings, which are made of Babbitt. The armature core is built up of discs of thin sheet iron, separated by paper, and each bobbin lies in a groove made in the metal of the core to receive it. There can be no movement of the wires, which is frequently the cause of burning out.

The pole pieces are cut from the best quality of hematite iron, and the field magnets are forged from old horseshoes, thus guaranteeing the best results with the smallest expenditure of energy.

The lamps are manufactured in sizes from 10 to 150 candle power. The socket is constructed with the utmost simplicity. Two kinds are used, the plain or keyless sockets. The key-sockets may be turned in either direction, and it is impossible to injure them by turning. The lamp when in position is held firmly in place, and cannot possibly jar or work loose.

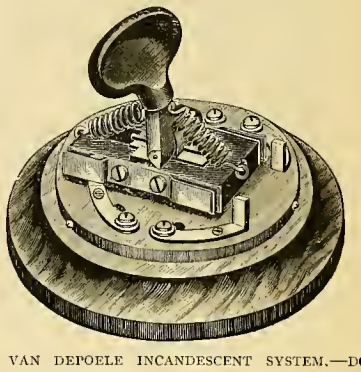


FIG. 2 VAN DEPOELE INCANDESCENT SYSTEM.—DOUBLE POLE SWITCH.—COVER REMOVED.

The Mayo double pole switch is employed in the system. Fig. 1 shows its form and Fig. 2 is a view with the cover removed. The switches form an absolute contact, and yields to a slight pressure.

Fig. 4 illustrates the voltmeter used in connection with the incandescent system.

The Mayo fuse box is illustrated in Fig. 5. It is manufactured under exclusive license by the Van Depoele company. If a fuse should be blown out all that is necessary to replace is the small strip of fusible wire, which is held in place by the cover.

The company proposes to use the Mayo series and series multiple systems where distances are too great to be reached economically by the direct system.

The armature of the Mayo dynamo is twelve inches in diameter, and is wound with 120 con-

volutions of .289 wire. Its resistance is .009 ohm. The resistance of the field magnets is twenty ohms. The voltage of the dynamo is 100 and the current required for each 16 candle power lamp is 54-100 ampere. The weight of the 300 light machine is 1,480 pounds. The claim is made that the lamps have an average life of 2,000 hours.

The Book Table.

FORTSCHRITTE DER ELECTROTECHNIK. (Progress of Electrotechnics for 1888.) First part. (January, February, March.) By Dr. Karl Streiker; published by Julius Springer, Berlin; 197 pages; type page, 7¼ x 4½ inches.

A review of the "Fortschritte der Electrotechnik" for 1887 was contained in a recent issue of the WESTERN ELECTRICIAN, and the purpose and the general plan of the work were noted. The compilation can be heartily commended.

PRACTICAL ELECTRICAL MEASUREMENT. By I. Swinburne; published by H. Alabaster, Gatehouse & Co., 22 Paternoster Row, London, and D. Van Nostrand, 23 Murray street, New York. Type page, 6¼ x 3¾ inches; 155 pages; 55 illustrations.

The author treats very clearly on electric measuring instruments and their use. In the preface he says: "In this book it is attempted to describe and discuss the various measurements necessary to the electrical engineer—that is to say, to write

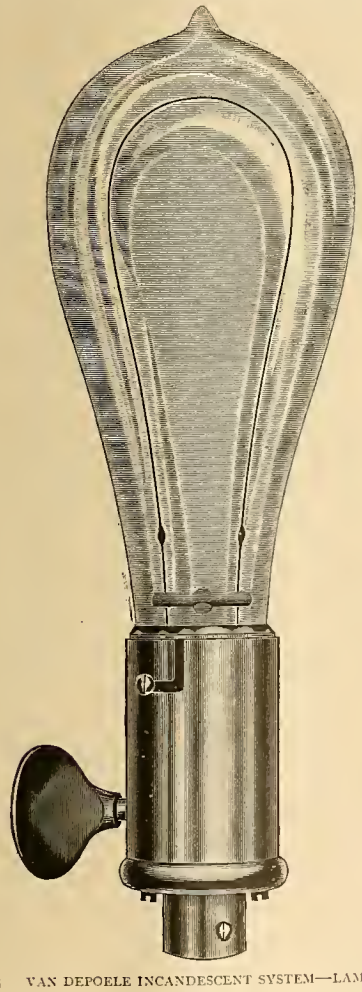


FIG. 3 VAN DEPOELE INCANDESCENT SYSTEM—LAMP AND SOCKET.

about electrical measurements in the workshops as opposed to mere laboratory practice. The different instruments in use are discussed somewhat critically, and their merits and faults, when they have any, pointed out. Such points as accuracy in ordinary use, portability or cheapness, are considered as of more importance than absolute accuracy under laboratory conditions." The book contains the following chapters: "Resistance," "Voltmeters and Ammeters," "Wattmeters," "Meter," "Winding of Voltmeters," "Calibration of Voltmeters," "Calibration of Ammeters," "Dynamos and Motors," "Batteries," "Arc Lamps and Mirrors." "Incandescent Lamps," and "Alternating Currents." The book gives a considerable amount of valuable information condensed into a small space Some of the statements, however, must be taken with a grain of allowance. For instance in Chapter II, "Voltmeters and Ammeters," the author says: "A very strong prejudice exists against the use of permanent magnets in measuring instruments. This prejudice is really unfounded, as a permanent magnet, *if properly made* in the first place, is constant enough for ordinary purposes." In reference to this statement, it may be said that large numbers of imported volts and ammeters having permanent magnets, when used in this country, are not constant enough. Probably they were *not properly made.*

The Electric Light and Danger from Fire.

Some curious experiments have lately taken place in the laboratory of the Paris Society of Electricians as to the danger of fire from electric lighting, says the London *Electrical Review.* It is needless to insist on the interest which these researches present, principally as regards the lighting of theaters.

An experiment was made with a bare wire placed on a small board, and in part covered with a second board. This wire should normally conduct a current of about four amperes. The current was carried up to forty amperes without the wood commencing to carbonize. For a current much more intense the wood took fire at the part where the wire is uncovered before burning the other part, where the want of air made inflammation slower. It is known that these accidents are avoided in a very efficacious manner in practice by the employment of fusible plugs.

In order to see to what extent the lamps themselves were capable of setting fire to strips and combustible bodies placed in their vicinity, the following series of experiments was carried out:

1. The globe of an arc lamp (Cance system) was enveloped in several thicknesses of a light material (green tarlatan).

2. A 32-candle incandescent lamp was enveloped in the same way, the folds of the material being joined under the lamp by an India rubber band.

3. A lamp of 32 candles was covered with a cotton cap of double thickness.

4. Another was covered with a calotte of black silk, which was in its turn covered with another of black velvet.

5. A lamp was surrounded by a layer of white wadding, off which the gummed surface had been taken.

6. Two lamps were covered with two layers of gummed wadding, white in one case, and black in the other.

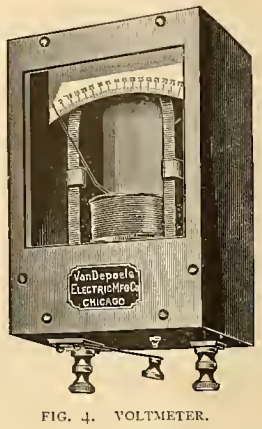


FIG. 4. VOLTMETER.

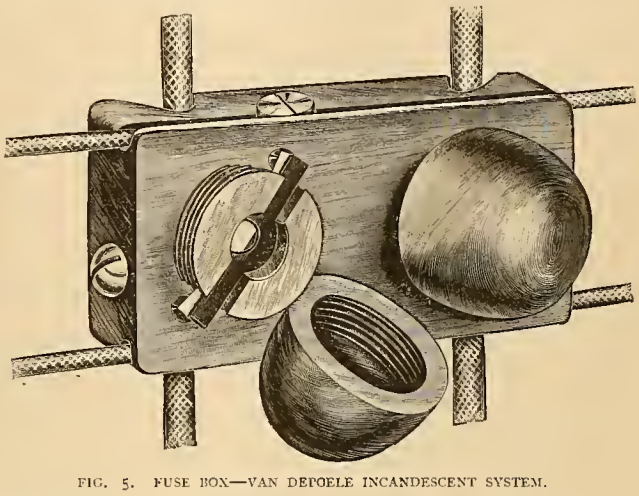


FIG. 5. FUSE BOX—VAN DEPOELE INCANDESCENT SYSTEM.

7. A lamp of 32 candles was placed in a vertical fold formed by an old theatrical decoration.

8. Lastly, a lamp of 300 candles was applied against an old decoration.

As regards the result, neither carbonization nor exaggerated heating was produced in twenty minutes in experiments 1, 2, 5, and 7. At the end of a minute and a half the decoration in experiment 8 carbonized at contact with the glass and began to burn without flame. At the end of two minutes, after melting and carbonization of the layers of wadding, the lamps in experiment 6 burst in, setting fire to the envelope. In about six minutes the velvet calotte was carbonized and began to burn slowly; the experiment was continued longer without breaking the lamp, but the glass was deformed. The cotton cap was partly carbonized at the end of ten minutes at the points of contact, but combustion had not then commenced.

M. Mascart, in giving his account of these experiments, the first of the kind yet held, we believe, on so complete a scale, has left to everybody the care of concluding, according to the application which he proposes to make of electricity, where the danger to be run begins and finishes.

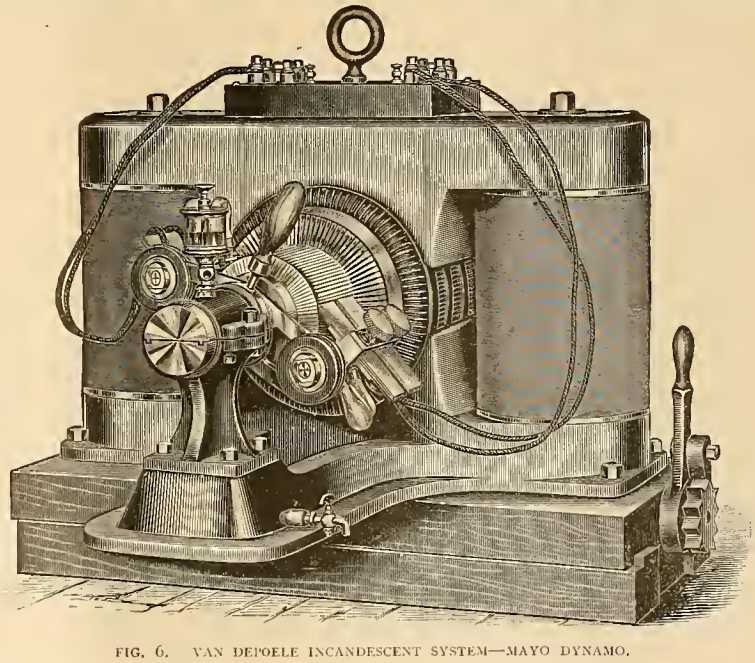


FIG. 6. VAN DEPOELE INCANDESCENT SYSTEM—MAYO DYNAMO.

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CONTENTS OF THIS NUMBER.

PAGE.

The Detroit Storage Battery, Illustrated..... 325, 326, 327, 328
Opposed to West Side Cable Road,. 325
St. Louis Telephone Company Victorious Over the Municipal Assembly..... 326, 327, 328
Van Depoele Incandescent System, Illustrated.... ..... 328, 329
The Book Table. 329
The Electric Light and Danger from Fire..... 329
Editorial 330
Sprague Electric Road at Boston, Illustrated 331, 332
Installation in Potter Palmer's Residence, Chicago..... 332
Edison Incandescent Lamp Patent in England..... 332, 333

DEPARTMENTS.

Correspondence..... 333, 334
The Electric Light..... 335
The Electric Motor 335
The Telephone..... 335
The Telegraph.. 336
Electrical Patents 336

In the New York letter mention is made of an instructor in electrical engineering who gives to his pupils exercises in line construction and pole climbing. Theoretical studies supplemented by practical instruction of this sort ought to develop thoroughly equipped electricians.

THE Chicago Electric club at its meeting January 7th will discuss the subject of insulation. The matter is one of the highest interest and the attendance at the club meeting will doubtless be large on the occasion. The members are expected to express their views on the matter in a general discussion.

A NEW form of storage battery is illustrated in this issue. The accumulator question is one which is exciting the greatest interest at the present day, and the use of storage batteries is rapidly extending. The process by which the new form is made is novel, and there are many interesting points in the construction of the cells.

WE publish in another column a sensational dispatch from New York to the effect that Henry Villard is engaged in the formation of a $40,000,000 electric light trust. We give this dispatch for what it is worth and exactly as it was received, but it is so full of inaccuracies and improbabilities that very little credence can be given to it. In our issue for December 8th we published an item to the effect that Mr. Villard had just secured a large amount of money from abroad for an electric light company, and gave the name of the company for which this money was obtained. This item had some foundation in fact. It was published by the WESTERN ELECTRICIAN exclusively, and has since been extensively copied by the press. Some enterprising press correspondent has evidently run across this item somewhere, and with the help of his imagination has evolved the startling telegram printed elsewhere. But we still adhere to the opinion we expressed last week, that the prospects for an electric lighting trust, in the full meaning of that term, are not improving.

AN article on the appeal in the Edison incandescent lamp litigation in England appears in another column. The reports consist of a synopsis of the speech made by Sir Richard Webster, the appellants' counsel. He gives in the course of his argument a highly interesting statement of the development of incandescent lamp construction

IT has been noted that when the telegraph was introduced in Persia, the natives made a practice of using the insulators as targets for rifle bullets. It seems that this amusement is not confined to Asia. A Nebraska telephone company is suffering from the same cause, and has found it necessary to offer a reward for the apprehension of persons shooting off its insulators.

TRUSTS are forming on every hand, and their operation has been felt in the electrical field. The copper syndicate has proved to every purchaser of wire that it has a firm grip on its product. The news is now announced that a syndicate is to be organized by influential Belgium and German financiers to control the zinc trade. They propose, it is said, to imitate the French syndicate in their methods.

MANUFACTURERS should keep in mind the coming electric light convention at Chicago in February, and make their preparations for a large exhibit early. A large number of applications for space in the exhibition hall have already been received by Chairman Sunny, and more are coming in daily. The success of the exhibition feature of this meeting is already assured, and those who have not made arrangements for space should do so at once, and thus secure an advantageous location.

AN experiment has recently been made with the phonograph, which illustrates one of the manifold uses which the instrument may serve. A physician employed the little machine in making a record of heart sounds. The experiment which was conducted by Dr. J. Mount Bleyer was completely successful. He says in his description: "All the sounds were heard, in their varied pitch and tone, as they came along, with perfect clearness. The words and sentences that I had spoken into it for the purpose of recording the landmarks were all reproduced. With some extra experimenting I was able to apply the use of the phonograph in such a manner as to throw the physical sounds, which had been previously registered upon one of these wax cylinders, into the auditorium, and thereby teach directly a larger class. It is further possible to construct a physical sign cabinet which has all registered cylinders representing the different diseases of the lungs and heart. When one wishes to study any of the sounds of the heart or lungs he can pick out of his cabinet that cylinder which has registered upon it such physical sounds."

LUCIEN GAULARD, whose name will always be associated with the alternating current transformer system, recently died in Paris under peculiarly distressing circumstances. That he was a genius is conceded, and that he was singularly unfortunate is not denied. To Gaulard belongs the honor of recognizing the importance of the alternating transformer system, and of bringing it to the attention of electricians. In connection with Mr. Gibbs he developed the system, and installed the first plant of the kind. George Westinghouse, jr., of America, saw at once the value of the Gaulard and Gibbs system, and purchased the rights for the United States. These are the fundamental patents of the company which bears his name. It was largely due to the electricians of that company and to Zipernowski and Deri that a change was made in the Gaulard and Gibbs system, by which the transformers, formerly connected in series, were run in multiple arc. This modification made the system self-regulating and practical for commercial use. His death has occurred just at the time when the system, of which he first recognized the value, is making tremendous progress. In his suits Gaulard was defeated. The consequent disappointment and financial loss weighed upon his mind until reason gave way. He died in an asylum where he had been confined since last summer.

THE decision in the St. Louis telephone case, which has been awaited with the greatest interest, has just been handed down by the Missouri Supreme court, and the opinion appears in full in another column. The result is a complete victory for the telephone company. The termination of the litigation is as important to telephone corporations throughout the country as to the St. Louis company. City councils, notably those of Chicago and Kansas City, have been awaiting the decision which, had it been adverse to the St. Louis company, would have been considered as a precedent warranting the aldermen in following the example of the St. Louis municipal assembly.

Judge Black's opinion is an able document. He assumes that the state has the right to regulate telephone rates, and says that the right to delegate this power to municipal corporations is equally clear. The question at issue, he says, is narrowed down to the inquiry, whether the city has received from the state the requisite power to regulate telephone rentals. The company is subject to reasonable regulations prescribed by the city, and in the case in point the rules have been obeyed by the defendant. Conceding these facts, Judge Black says he fails to see that the right to regulate prices follows. The power, he finds, is neither included nor incidental to the power to regulate the use of streets, and the St. Louis ordinance could not be upheld on that ground. Judge Black says the charter provisions taken together cannot confer on the city the right to regulate telephone rates. Such a view would be extreme, and it would follow that the city might regulate telegraph charges and other services of a public character.

The St. Louis legal department and the municipal authorities of that city announce their intention of appealing to the legislature for a grant of the necessary power to regulate rates.

How this decision is received in Chicago, where the controversy between the city council and the telephone company is in progress, is noted elsewhere. The result will tend to make the aldermen more cautious in their treatment of the question. The telephone company feels that its position has been greatly strengthened.

The members of the Chicago city council say they do not regard the decision as one of great significance as far as they are concerned. Alderman Hamline says the Chicago council has the incontrovertible right to say upon what terms the company may use its streets for the purpose of carrying their wires through them, and it can make one of those terms the condition that the company shall not charge more than a fixed sum for the use of their instruments. Where the city council of St. Louis erred, he says, was in trying to fix the rates to be charged without reference to making that a condition in consideration of which the right to use the streets was granted.

At the last meeting of the Chicago council the finance committee presented its report, of which the following extract covers the essential features:

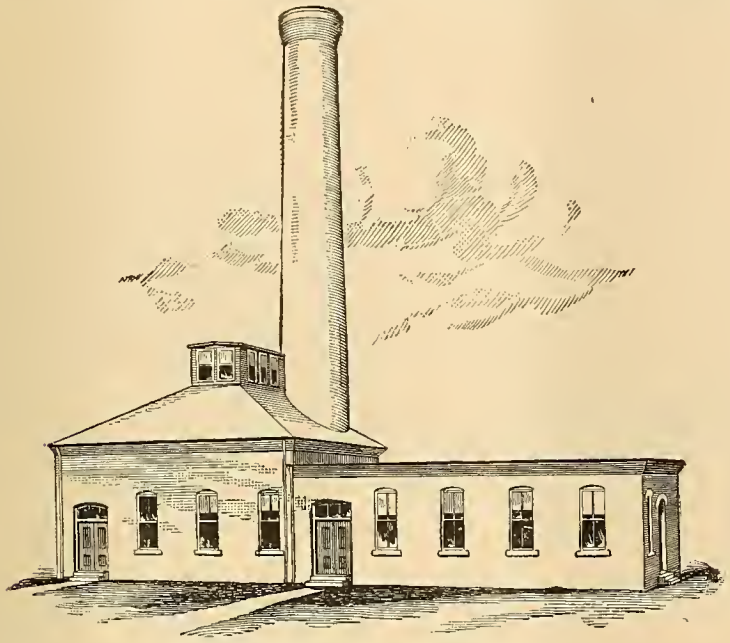
"It is doubtful whether the courts would declare a forfeiture against the (Bell) telephone company, when the city has since the location of the company's lines and wires received free use of the instruments specified in the original ordinance, and when the city has by contracts with said company received special rates for telephonic connections for the use of various departments, and when all permits have been taken out in the name of the Bell Telephone company up to Jan. 1, 1886, and when subsequent to that date by orders of said city officials duly reported to the council, permits which had heretofore been issued to the Bell company were directed to be and were issued to the Chicago Telephone company."

In view of these facts, and that the corporation counsel has decided that the council has not the right to fix rates, and of the decision of the Supreme court of Missouri, the majority report recommends the adoption of the 3 per cent. tax ordinance.

Sprague Electric Road at Boston.

Several views of the new electric street railway running from Boston to Brookline, are shown in the accompanying engravings. The road was installed by the Sprague Electric Railway & Motor company of New York. Several trial trips have been made over the road, and the apparatus, which has been found perfectly satisfactory, will be put into commercial operation in a few days.

The West End street railway of Boston, of which this road is a part, is the largest street railway in the world; it extends over twelve miles of track, and the company uses 1,700 cars and more than 9,000 horses. The president of the company, Henry M. Whitney of Boston, is recognized as one of the most enterprising and successful street railway men in the country, and aided by an efficient corps of assistants, has succeeded in giving Boston, since his administration, the most efficient street railway service which ever existed in that city.



SPRAGUE ELECTRIC ROAD AT BOSTON—POWER HOUSE.

Before deciding upon any electric system for the West End road, President Whitney, accompanied by members of the board of directors and managers, visited the principal electric railways in the country operated upon the various systems, including visits on three different occasions to Richmond, Va., to inspect the electric road in operation there upon the Sprague system. After a most careful examination of these roads, the contract for equipping the West End road was awarded by the board of directors to the Sprague Electric Railway & Motor company of New York.

This system of electric railway called for in this contract is wide and comprehensive. The main line from Boston westward, beginning at Park square, will run down Boylston street bridge and thence down Chester Park to Beacon street. It will then proceed over the Beacon street extension to the Chestnut Hill reservoir, and to Allston and Oak Square, Brighton. From the east park gate over the new boulevard to the Chestnut Hill reservoir and Brighton the Sprague overhead system will be adopted. In the more crowded streets of the city the Bentley-Knight conduit will be used, and the Sprague cars will run over the whole system.

The power station, from which the electric current is distributed to the line, is situated on Braintree street, Allston, near the Boston and Albany railroad, and also at the edge of the water, thus giving both water and rail facilities for fuel. This building, said to be the most perfect electric plant of its kind in the country, is situated very nearly equidistant from the terminals, and is therefore literally a central station. The station, with the adjoining car-house, is of brick, and entirely fire-proof.

In its construction it was the aim of the West End company to get the best in every detail. The chimney stack is 100 feet high. The boiler house, which is both convenient and commodious, is at present equipped with three horizontal tubular boilers, furnished by the Jarvis Engineering company. The engine room contains two high-speed automatic cut-off engines of the Armington & Sims pattern, of 200 horse power each. Each drives two powerful dynamos of 80,000 watts each, and wound for a maximum pressure of 500 volts. These dynamos are of the highest efficiency and simplest construction, and if need be, can be placed under the charge of the steam engineer. The dynamos feed into copper bus wires, supported on the walls by porcelain insulators.

Each machine has its independent ampere meter, and in addition there is a general ampere meter at the end of the positive bus bar. From this bar the current passes to special snap switches, each switch being connected through a three-plug safety switch back to one of the feeders supplying current to the main line wire. These feeder wires tap into the line wire at different points on the line of road, thus maintaining the pressure approximately equal all along the line. At the end of the feeders in the central station pressure indicators are attached, which indicate the voltage at the junctions of the feeders with the main current wire.

The engine room is brilliantly lighted by handsome hanging electroliers, each of which has five incandescent lamps. A switch-board at one end of the room furnishes an independent control for each group of lamps. All the surroundings of the machines are kept in the neatest condition.

Adjoining the power house, but separated by thick brick walls, is a commodious house for accommodation of cars, 107 feet long by 80 feet deep, designed to hold twenty-four cars.

The overhead system, which is built under the Sprague pattern, is of the finest description, and includes iron poles set in concrete throughout the entire length of the road. These poles are of a very neat and tasteful pattern, and support the span wires which carry the trolley wire at a height of eighteen feet over the center of the track. This overhead wire, which is used for a working conductor, is made of silicon bronze, of the small Sprague type, only three-sixteenths of an inch in diameter. This is the only wire suspended over the middle of the track, and its lightness and high tensile strength allow the overhead supporting structure to be of the lightest description possible. The poles are 125 feet apart.

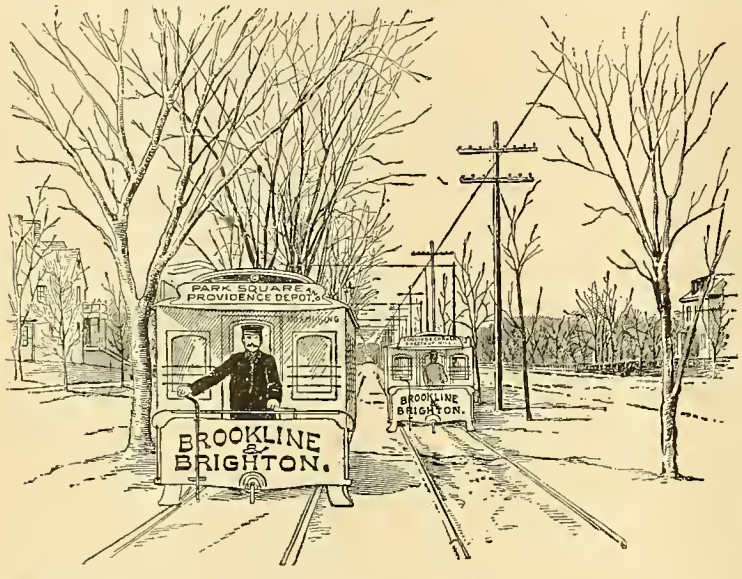
The return circuit is through the rail, and thence by both metallic and ground circuits to the station. Each section of rail is joined to copper ground wires throughout the length of the road, underneath the string pieces. At intervals of 500 feet this ground wire is connected to an earth plate, and at seven points widely distributed. The ground wire is connected to the station, and there is also a main ground connection made there through a large sink-plate.

In the overhead system a new method of switching has been adopted which is at once ingenious and simple. Five or six feet inside the turn-outs a small switch with flaring rider is interpolated into the main and branch wires, and a spring tongue upon this directs the path of the trolley with absolute certainty and ease. By this means switching is made very easy, and all danger of the trolley leaving the wire is obviated.

The cars can be run at widely different speeds, varying from the slowest crawl to twelve or more miles an hour. They can be started and stopped without the use of brakes in the space of three or four inches, and when making the normal running speed can, in an emergency, be stopped and reversed without brakes within less than one-fourth of a car length. This feature is especially advantageous in crowded thoroughfares, and shows the superiority of the electrical car over the horse or cable cars. The control over the car seems marvelous, for one sees little or nothing save an almost imperceptible movement of the hand of the motor-man; and the starting, although prompt, is very gradual and without shock or jar. The ordinary driver can

SPRAGUE ELECTRIC ROAD AT BOSTON—BEACON STREET DIVISION.

operate one of these cars without the slightest trouble after very brief instruction. The saving, owing to the superior quality of the apparatus over an ordinary horse car line, constitutes no inconsiderable item. It has been found that the average cost of motive power per car a day throughout the United States, that is, for from ten to eleven hours, and trips aggregating from 45 to 50 miles, is about $4, and this estimate counts only those horses on actual duty on the road. The cost of motive power per day per car for equal mileage in Richmond is less than $2 on the heaviest sort of grade work, and at Boston it is estimated that even this low cost of



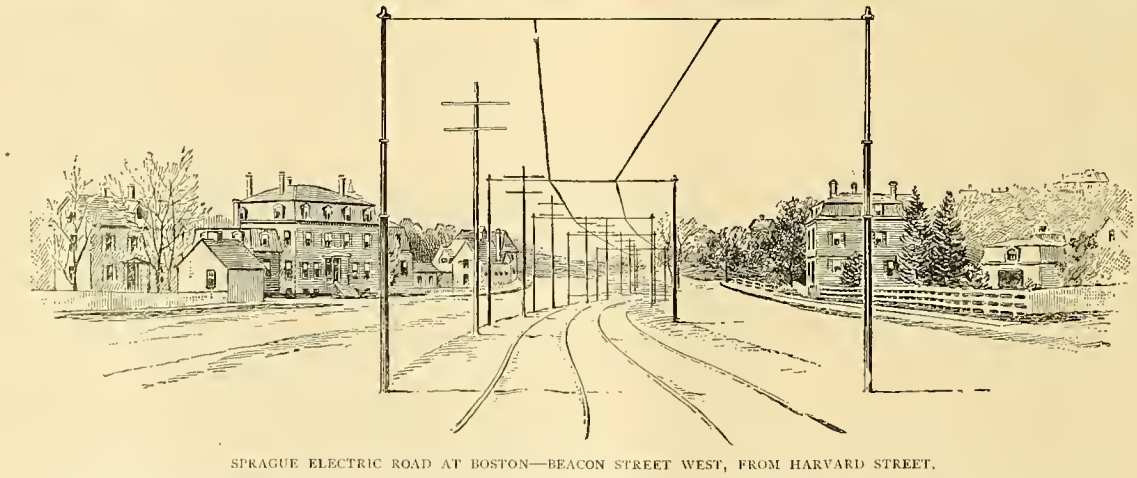
SPRAGUE ELECTRIC ROAD AT BOSTON—BEACON STREET WEST, FROM ST. MARY'S STREET.

operation will be reduced. For winter use upon this road the Sprague company is equipping three electric working cars, furnished with snow plows, brushes, ice-cutter and salt distributor, and each propelled by two powerful 30 horse power motors. In front of the car is a revolving wheel which breaks up the snow crust completely, and behind are revolving brushes which sweep the tracks clean. It is estimated that this revolving car will clear a street railway track after a heavy storm more quickly than the ordinary snow-plow, drawn by twelve horses.

The system of wiring which the West End management has adopted for the crowded city streets is the Bentley-Knight conduit now in use in Allegheny City, Pa. Here the conduit is laid midway between the tracks, and is strongly bolted to the stringers and sleepers. Its cross-section is about a foot square, and its upper part has a slot similar to that used in cable railways; its width, however, being only five-eighths of an inch, giving an opening so small that carriage wheels will not catch in it. Besides this, it is so beveled that horseshoe calks will not be held in it. Copper bars one and a quarter inches thick, one on each side of the slot, firmly insulated beneath it, carry the current, one from the dynamo and the other returning from the motors. The current is taken from the conductors to the motors by "plows," as they are called, two to each car. These plows are thin iron plates about 10 inches square, hung from a framework over the middle of the track and projecting into the slot. The motors are connected by controlling switches, and the car is operated substantially as is the overhead system. The plows are so arranged that they can be lifted out of the slot when any obstruction is reached. The current is taken up and returned by spring plates, which slide along the copper conductors at the bottom of the plow.

In switching two ordinary tongue switches are used—one in the conduit and one on the rail. Brushes attached to the snow plows and cars easily keep the conduit and tracks clear, even in the severest snowstorm or in case of slushy or muddy weather. The change from the overhead system to the conduit is made while the car is in motion, and without the slightest delay in travel or inconvenience to passengers, so that the Sprague cars run over the entire distance.

The kind of truck used upon this road is the latest Sprague improved truck, which has been fully described in these columns. The equipment of this truck includes the new Sprague "Boston" motor which will be used for the first time in commercial work upon this road.



SPRAGUE ELECTRIC ROAD AT BOSTON—BEACON STREET WEST, FROM HARVARD STREET.

Installation in Potter Palmer's Residence, Chicago.

The Electrical Accumulator company, represented by Conant & Hood, Chicago, will make an interesting installation in the elegant residence of Potter Palmer, on the Lake Shore drive, Chicago. The house has been hitherto lighted by gas, but its effects were becoming apparent in the discoloration of many of the paintings and decorations. The house was wired at the time of its construction, but as Mr. Palmer has been unable to secure a supply of current, he has decided to purchase a plant of his own. The Accumulator company will install a battery of one hundred and twelve 15-A cells, which will be charged by a 150 light United States dynamo. The motive power will be supplied by a gas engine. The intention is to charge the cells by day, and they will furnish current enough for ordinary use. There are 250 lamps in the residence, and if it is desired at any time the cells can supply part of the circuit, and the remainder will be furnished directly from the dynamo. The plant will be located in the barn, and the conductors will run under ground to the house. By the terms of the contract the installation will be completed February 1st.

Edison Incandescent Lamp Patent in England.

The case of the Edison and Swan Electric Light company against Holland and others came up on appeal in London the first week in December. The appeal is from the decision of Justice Kay, who found that the patent of Edison's incandescent lamp was not protected because the method of working was not sufficiently set forth in the specification.

Sir Richard Webster said he appeared on behalf of the appellants in respect of the infringement of two patents vested in the Swan United Electric Light company, and known as the Edison patent and the Cheesbrough patent. Both patents were before the court in the case of Edison vs. Woodhouse and Rawson. The Edison patent related to the mode of construction of an incandescent lamp; the Cheesbrough patent related to the method of preparing in a better way the conductor to be used in incandescent electric lighting—that was to say, the carbon. Justice Kay found for the plaintiffs in respect to the Cheesbrough patent, relating to the improved method of conducting the material of the conductor, and he found on a number of issues for the plaintiffs in the Edison patent; but he found one matter against them, namely, the deficiency in the specification as to the method of working. There was no appeal against Justice Kay's decision with respect to the Cheesbrough patent; the judgment for the plaintiff, the injunction and the consequences stood as in Justice Kay's judgment. This appeal was by the plaintiffs against that part of the judgment of Justice Kay which found for the defendants on the ground that objection could be taken to the Edison patent. Among the issues which were found for the plaintiffs was that Mr. Edison was the true inventor, the combination which he described was new, and that the defendants had infringed; but at this late day in the life of this patent the learned judge found that there was not sufficient information given in the specification to enable a competent workman to construct this combination. Justice Kay applied to this specification the test of commercial utility as distinguished from utility generally. He would in the course of the case have occasion to call attention to legal authority to show that the test which Justice Kay applied in construing this specification was incorrect in law. The attorney general said he proposed to state as fairly as he could what was the existing state of knowledge at the date of the patent. Having done that he proposed to call attention to the specification of Mr. Edison, and to see what was the invention on the face of the specification. He then pro-

posed to take the judgment of Justice Kay, and to show the errors into which the plaintiffs alleged that he had fallen, and then to bring before their lordships' attention so much of the evidence as had a direct bearing on the issue raised by Justice Kay's judgment. The experiments upon which the sufficiency of this specification was attacked were substantially experiments made after the trial of the action had been actually commenced. He would be able to demonstrate that the defence as to the insufficiency of the specification was a complete after-thought, the experiments upon which the attack was made having been made after the principal witness for the plaintiffs had been examined.

The attorney general then proceeded to deal with the state of knowledge at the date of Edison's patent, which was dated November 10, 1879. The leading features of the incandescent lamp were then described at some length. The earliest incandescent lamps were made in the year 1845. From 1845 down to 1879 these attempts went on, the experiments being revived from time to time, without any success at all, or rather without any success which led to the development of incandescent lighting. In the specification of 1879 Mr. Edison no doubt did disclose things which formed a part of Mr. Swan's patent. Mr. Lane-Fox had previously discovered that high resistance lamps were more likely to succeed than lamps of low resistance, and he devised a means of mixing up non-conducting material with conducting material, as for instance, asbestos with carbon, but the idea of a carbon filament wholly escaped him. So far as prior knowledge was concerned this was about the condition of makers; it was known long before 1879 that one could raise to incandescence conductors of various kinds; known long before 1879 that carbon was a suitable conductor; known that high resistance lamps were likely to be of more advantage for the purpose of incandescent lighting as compared with lamps of low resistance; known that a vacuum was the proper condition for the success of these lamps; but it had occurred to no one that a simple carbon in the shape of a filament was sufficiently strong to fulfill the conditions. Therefore, when Mr. Edison grasped the idea and enunciated it in a form capable of being carried into practical effect, a step was made in connection with the invention. For forty years people were trying to overcome the difficulties of electric lighting almost in the same way, and Mr. Lane-Fox tried to perfect an incandescent lamp by strengthening the bridge by the use of non-conducting materials, because he thought conducting materials had two effects—those that were of sufficiently high resistance were too weak to stand the strain; those that were strong enough were bad conductors. Then there was the discovery of Justice Grove with reference to platinum wires; but though platinum was a good conductor the current required was so large that the glass was cracked by the heat used to raise the platinum wire to incandescence.

A notable name that would figure in the case was that of Joseph Wilson Swan, to whose indomitable perseverance the present perfection of the lamp was due. Having worked at the matter for fifteen years, in the autumn of 1878 Mr. Swan got the nearest approach that was ever made to the Edison lamp or the subsequent Swan lamp prior to the publication of Edison's specification. He would state, to be accurate, that the lamp was made by Stearn, but it had always been called Swan's lamp, and was really the outcome of mutual experiments made by Swan and Stearn. It consisted of a globe of glass, with platinum leading wires, and of a pencil or stick of carbon, the history of which was not known when the case of "Edison *vs.* Woodhouse and Rawson" was originally before Justice Butt, but had since, fortunately, been fully ascertained from Mr. Swan himself. The lamp was made in December, 1878, but although Mr. Swan and Mr. Stearn had worked the matter out theoretically and, to a certain extent, practically, the result they arrived at positively led people astray, and it led even Swan and Stearn themselves in the wrong direction. The most powerful argument that could be adduced in favor of Mr. Edison was the evidence of the men who were supposed at that particular time to have anticipated Mr. Edison's invention, not publicly, but in their own minds, and it was now fully recognized and admitted that Edison had anticipated Swan in this discovery. Although the experiments of Swan and Stearn had been a great success, and although it was admitted they had come close to Edison's invention, yet it led Swan and Stearn completely wrong, so little did anybody think that the solution lay in the direction of a filament of carbon; so little did they know its flexibility, its resilience, and other characteristics. After the supposed anticipation of Edison, through the year 1879 Stearn and Swan were experimenting with a view to a patent, and the defendants attempted to set up the case that they produced a lamp with a carbonized thread which was the same thing as Edison described. In the summer of that year, said the defendants, Mr. Swan showed to a number of people carbonized thread lamps, which were working to the number of hundreds at Newcastle; but Justice Kay had found for the plaintiffs that, even if such evidence were true, any such attempts were wholly experimental. As a matter of fact, it could be shown, if necessary, that these witnesses were misstating the time, and that no thread lamp was ever made by Swan until January, 1880, a date fixed clearly by the fact of a fire at Mr. Swan's works by which everything was burned down, so that he had to start *de novo*. But besides this, there was the statement of Messrs. Swan and Stearn themselves, that they never did make a thread lamp until after the publication of Edison's specification, or ever even tried to carbonize thread. Of course, if the defendant could prove publication by Swan prior to 1879, he must absolutely succeed, but both Swan and Stearn stated that the thread lamp of Swan was not made until the year 1880. That point was of the gravest importance. As a matter of fact, nothing nearer to Edison's lamp than Swan's lamp of 1878 was ever published. Swan and Stearn both failed to realize that they might make the carbon very much smaller than it was in the lamp of 1878; they still thought they must have a strong and relatively massive carbon conductor, and they were working in the direction of strengthening and thickening the carbon instead of thinning it and making it filamentary. It was no exaggeration to say that every single effective incandescent lamp, of which there had been hundreds since the date of Mr. Edison's specification, might be in terms described in the words of Edison's specification, and indeed, Stearn wrote to Swan before the specification came over, "If Edison means carbon, we are anticipated." That statement was in black and white, and was of itself quite sufficient to dispose of the idea that Swan had already made the lamp in 1879.

Beyond the fact that Edison did not know accurately everything that had been done in England, the specification would be found to be not an incorrect summary of the state of knowledge at the time. Edison was not quite aware of what had been done in some respects in England. One objection taken against the specification was that the words "properly carbonized" did not convey sufficient information to enable persons to carbonize, but there was not the slightest foundation for saying that the term was not perfectly understood and known by persons having to do with the carbonization of articles. The description of the filaments as "fibrous vegetable substances coiled" as a description of the most successful electric lamps, was applicable to this day, and except in so far as they differed in construction they answered exactly to the description which Edison had enunciated in his specification. Then Edison went on to say, "I have discovered that carbon filaments may be made by a combination of tar and lampblack, the latter being previously ignited in a closed crucible for several hours, afterward moistened and kneaded until it assumes the consistency of thick putty." That was stated by the defendants not to convey sufficient information to enable a person to do it. The process also was said to be impossible and absurd, and so bad was the specification said to be by some of the defendants' witnesses, that they had never tried it. Others said they had tried it, and had failed to do it. But he could show that it was done by boys and girls in the most ordinary and common way, and without the slightest attempt at skill or scientific construction. Everything in the specification had been shown to produce a useful lamp. Then it was said that the making of filaments in this way could only be done by a trick, as the ignition would burn the whole thing up, but it was proved to be possible by the referee appointed by Justice Kay. But when Justice Kay came to deal with the matter, he disregarded everything that the referee had said with regard to its feasibility or practicability. The specification also said that small pieces of this substance might be rolled out to the size of $\frac{1}{10000}$inch. One witness said it was impossible to get a size less than half a millimetre, and that it could not be carbonized, as it would all be burnt up in ash, but it was proved by plaintiffs' witnesses that hundreds of filaments as thin and thinner than this were made by a boy, and carbonized afterward without difficulty. Filaments in accordance with the various processes were actually made in court or in a chamber adjoining, under the very eyes of the learned judge. When he came to deal with the evidence of the defendants' witnesses, he would say, unhesitatingly, that they failed because they did not take pains to succeed.

CORRESPONDENCE.

New York Notes.

NEW YORK, Dec. 20.—The meeting of the American Institute of Electrical Engineers, December 18th, was held at the College of the City of New York, where the increasing attendance is more carefully accommodated, and facilities offered for illustrating papers with the lantern. The paper read by W. J. Jenks, director of the standardizing bureau of the Edison Electric Light company, was devoted to a thorough review of six years' practical experience with the Edison chemical meter. It was very interesting in its narration of the gradual evolution of the improved meter of to-day from the many ingenious devices which Mr. Edison invented and patented at different times, all of which were shown on the screen, and fully explained by the lecturer. Curiously enough the discussion brought out a sturdy defence of the much-maligned gas meter, and Mr. Crocker stated that as a matter of fact all meters must, if defective, register against the company. The manipulation of figures with pen and ink was another question.

The Harold P. Brown controversy is still "on," the latest manifestation being a challenge, contained in an advertisement appearing in the daily *Times* and *World*, of which the following is an extract: "I am prepared further to prove my theory in practice by records of a large number of deaths already caused by the alternating current, and to prove by affidavits and otherwise that this same current has already, in numerous instances, crippled, paralyzed, or otherwise injured for life a number of men, several of whom are now pensioned by the alternating current interests. Notwithstanding all this, for reasons of a merely selfish commercial nature, Mr. Westinghouse advertises the death-dealing alternating current as less dangerous to life and limb than the continuous current. I therefore challenge Mr. Westinghouse to meet me in the presence of competent electrical experts and take through his body the alternating current while I take through mine a continuous current. The alternating current must have not less than 300 alternations per second, as recommended by the Medico-Legal society. We will commence with 100 volts, and will gradually increase the pressure 50 volts at a time, I leading with each increase, until either one or the other has cried enough, and publicly admits his error."

One of the leading electricians of the country says he would be willing to accept this challenge under the conditions named, but objects to the manner in which it is being handled as calculated to make it a sensational affair, although, of course, it will amount to nothing. It is rather curious that just as this question of electrial executions is being discussed, one elephant "chief" should be sentenced to death in Cincinnati by his owner, Robinson, and a proposition made to execute him by electricity, while another "chief" was also condemned to die at Philadelphia by his owner, Forepaugh In the latter case the sentence has been carried out by the "rope" in old-fashioned style, a turn being taken about the victim's neck, and the line being hauled taut by two of his elephantine associates.

A verdict of $626.50 has been awarded to George H. Holt in a suit brought by him against the Holmes Protective association, which undertook to guard his house against burglars last summer. In spite of the alleged protection,

Mr. Holt, upon opening his house, discovered that $1,965.50 worth of jewelry and clothing had been stolen.

Considerable difficulty is being experienced by the people who are attempting to introduce the alternating system of electric lighting in this city, arising from the restrictions of the underwriters' inspector. Efforts are being made to comply with all the requirements, however, and it is believed the delay will be merely temporary.

E. P. Roberts, assistant professor in the electrical engineering department of Cornell university, is spending his holiday vacation in this vicinity. He is making good use of his practical experience in electrical work by giving his students exercises in line construction, pole climbing, etc., as well as in what are considered the higher branches. An electrical engineer who has "won his spurs" and can "climb" alongside of the old hands will certainly be treated with more respect than is usually shown to graduates who are just entering the school of experience where they are supposed by their work to earn their daily bread. The prospect of remuneration as a lineman is probably more promising than the managership of a central station, where skilled men are frequently expected to work long hours for from $60 to $65 per month. P.

Omaha, Neb.

OMAHA, Neb., Dec. 19.—The electric cars on the motor line across the new bridge between this city and Council Bluffs, Ia., over the Missouri river, have now been running a little over a week. The first car started from Council Bluffs at noon, and reached the Omaha side in twenty minutes. A twenty-minute service has been established until the operators shall have become a little more familiar with their work. Since the first day every train on every trip has been crowded with passengers, and it is stated that each train's receipts have averaged $40. The trains are made up of two coaches, in charge of a conductor and "motor man." The line is four miles long, extending from Tenth and Douglas street, this city, to the heart of the business portion of Council Bluffs. One train made the trip once in sixteen minutes—a mile in four minutes. From Omaha to the eastern end of the bridge in Council Bluffs there is but one track, but the remainder of the line is double track. The cars and their motive power are still subjects of great curiosity, and every time a train stops the passengers pile off to investigate the cars.

The Omaha Electric Motor company, of which Dr. Mercer is the leading representative, is simply having a peck of trouble, and is also causing the city authorities a peck of trouble. The cause is the objection of the city to the erection of poles by the company, and the determination by the company that it will erect its poles. The city has an idea that it has enough poles, and it desires all wires hereafter to be put underground. Dr. Mercer has exercised every possible ingenuity in getting the poles up in spite of the city's objections. He had gangs of men work at night, then on Sunday; then he had the poles put up in broad daylight on week days. The Electric Light company is all the more willing to aid the doctor, because both are or will be using the same company's system, the Thomson-Houston. Dr. Mercer is especially anxious to get the poles up from the termination of the Omaha & Council Bluffs line at Tenth and Douglas streets to the Millard and Arcade hotels, at Thirteenth and Douglas streets, which would give him a big patronage now. The hotel people are anxious for that extension also, and petition the council to grant the company the right to build that far, but the petition was pigeon-holed. In the meantime the city has obtained an injunction against the Motor company, restraining it from erecting poles.

The question of poles has become serious in Omaha. They are becoming so thick that the companies themselves find it very convenient to have them painted different colors in order to pick out their own property. Negotiations are pending for the establishment of another company with poles—an incandescent electric light company.

Three years ago Omaha was the relay station of the Western Union on the overland line, and the Wheatstone did an immense amount of work. Then a copper wire was strung to Ogden and the relaying was transferred to that point, and an operator was left at this point to watch the line during the day and relay if the wires worked badly. In the meantime the Morse system was used for overland night work. Now the night messages on their overland line are to be sent by the Wheatstone system, and a night operator put on, while eight of the ninety Morse operators in the office lose their positions.

The Union Pacific is not remaining with its hands folded pending Judge Brewer's action on the injunction asked by the Western Union, but is printing blanks for commercial messages and separate telegraph accounts, and getting in shape to do a distinct telegraph business, as Congress has decreed.

Emil L. Opperman of the Brush Electric company is in the city looking over the field with a view of establishing here a system of incandescent lighting for business houses and residences. The first rates proposed are 70 cents a light for such as burn till 10 o'clock in the evening, 90 cents for 12 o'clock lights, and $1.80 for all night lights. It is the purpose of the company, if it establishes a plant here, to provide light in the daytime also, if there is a demand for such. The company proposes furnishing motors also for manufacturing purposes.

At Warnerville, Neb., complaint is made that boys amuse themselves by shooting away the telephone insulators. The company has offered a reward of $25 for information that will lead to the conviction of the guilty persons.

Ashland, Neb., is to have electric lights. The power will come from the mill water power. E.

Kansas City, Mo.

KANSAS CITY, Mo., Dec. 20.—A new toll line board has just been added to the equipment of the local exchange of the Kansas & Missouri Telephone company. It has a capacity for thirty toll lines, and begins operation with twelve lines, including the metallic circuit between this city and Topeka, Kan., and a smaller one between here and Liberty, Mo. It is the joint product of the company's carpenter, Downey Lingstone, and electrician, Albert Barratt. It was made with a view to attaining the greatest possible speed, and is a model of convenience. It will be operated by three young ladies, who will find their labors greatly lessened by means of the little improvement introduced by Electrician Barratt—a system of double jacks. Superintendent Smith exhibits the board to visitors with a great deal of pride.

Superintendent Smith states that during the past year the company has torn down and replaced with cables seventy-five miles of wire, which has been in use for five or six years. Some of the wire had been reduced by the elements from No. 12 to No. 32. Most of it had become so worthless that a break in it could not be repaired.

E. Follingsby of Fredonia, Kan., has contracted for a 30 arc light plant to be established at Burlington, Kan. The contract for the plant was let to the Thomson-Houston company through Charles H. Rusling, the Kansas City agent. The Baxter Springs Electric Light company has let the contract for a 50 incandescent alternating plant to Charles H. Rusling, the Kansas City agent of the Thomson-Houston company. Work will begin on the plant at an early day, and the building and equipments will be first class in every respect. J. R. Hamacher & Bro. of Richmond, Mo., will put in a 35 arc light plant of the Thomson-Houston system. The contract was secured by the Kansas City agent of the Thomson Houstom company, Charles H. Rusling.

Topeka, Kan.

TOPEKA, Kan., Dec. 18.—Superintendent Smith of the Kansas & Missouri Telephone company was in the city last week looking after the affairs at the company's exchange in this city. He was especially interested in the putting in of a new multiple switch board which will have a capacity for 600 telephones.

A petition was read from the Topeka City Railway company, at the last meeting of the council, asking permission to do such work in the streets as may be necessary to construct and operate an electric motor system for propelling the company's cars. The system is to be the very latest and most approved, and can be adapted to any system of poles, either such as can be set on both sides of the streets, or such as are set in the form of light cranes by the side of the various tracks. The ordinance under which the company operates its lines permits any system of power except steam. The petition was referred to the committee on streets and walks.

The Rapid Transit company is still engaged in fixing its track in shape preparatory for the adoption of the electric motor system. It was the aim of the company to have the new line in operation by January 1st, but it has since become evident that it will be impossible to do so. There will probably be five trains at first. B.

Council Bluffs, Ia.

COUNCIL BLUFFS, Ia., Dec. 20.—The Union Pacific railway and bridge connecting this city with Omaha did a big business at big rates before the new bridge and the motor line were constructed, charging fifty cents for passage from one city to the other over its lines. Since the new bridge has been completed the Union Pacific has steadily lowered its rates, and now has entered into an agreement with the motor line to charge only ten cents, and do away with all commutation tickets.

A representative of the Hawkeye Electric Light company of Oskaloosa, is in the city endeavoring to secure a franchise from the council for the operation of an incandescent electric light plant. At the last meeting of the council an ordinance granting it a franchise was read for the third time and then referred to a committee for further investigation. The Council Bluffs Electric Light & Power company introduced a petition praying that no charters be granted any company for at least one year, agreeing on its part to furnish an incandescent light to the citizens at one cent an hour for a 16 candle power lamp. An effort was made to have a committee appointed to visit the leading cities in the state and investigate the operation of incandescent systems, but the proposition was defeated.

In a discussion of the question of poles in the street the Council Bluffs correspondent of the Omaha *Republican* says:

"Some would be enterprising citizens object to the placing of poles on the streets of the city. It would be better to have the poles so thick that one could hardly squeeze through and have a well lighted, bustling, active city than to have the streets clear of poles and devoted to the raising of hay. Unless the good Lord sees fit to remove a lot of our old fogies it will be a good many years before the poles will be much in the way, and when that time comes, if it ever does, the matter will speedily regulate itself." D.

Birmingham, Ala.

BIRMINGHAM, Ala., Dec. 18.—Few people understand and appreciate the amount of work done by the newspaper men and telegraph operators of this city since the recent attack on the jail that holds murderer Hawes. In addition to the immense amount of special news matter sent to the papers all over the country, the number of private telegrams sent and received Sunday, Monday and Tuesday following the fight were double the ordinary business of this office. Manager Williams, Night Manager Sutphin and their assistants worked day and night for three days with scarcely time for meals. When the terrible affair of Saturday night occurred there were only two operators on duty at the Western Union office, but some of the day force came in later and worked until morning. After midnight 20,000 words of special telegrams to newspapers were sent away, besides a large number of private telegrams. Sunday the local correspondents sent out 80,000 words of special telegrams. Monday night 40,000 words were wired as specials, and 3,000 as Associated Press matter. The business of the office was handled promptly throughout the emergency. So rapid and excellent was the work done at this office that the districts and general superintendents of the Western Union Telegraph company complimented the entire force. Tuesday night all the correspondents in the city signed a complimentary notice of the good work of the operators, which was sent to the Associated and United Press, and by them sent to all the papers in the country.

The Florence, Ala., Electric Light & Power company has purchased a 40 light arc and incandescent Waterhouse plant. J.

Denver, Col.

DENVER, Colo., Dec. 17.—Queen City lodge, No. 1, United Order of Linemen, gave its first party last week in the chamber of commerce. The hall was beautifully decorated with 170 colored incandescent lights which were strung across the room about six inches apart. Over the stage at the end of the hall, a star set with forty colored lights attracted considerable attention, and added to the brilliancy of the scene. Outside the building was six 2,200 candle power arc lights. The organization is composed of telegraphers, electric and telephone linemen, and is a benevolent order. Dancing was engaged in during the evening, and an elaborate spread served.

The second electric light company which began operations at Pueblo, Col., with incandescent lights less than a month ago, has decided to double its building and plant so as to supply arc lights, thus competing with the old company in both kinds of electric lights.

The Trinidad, Col., Telephone company is putting up poles; an effort is being made to get everything ready by January 1. Ninety three telephones have already been ordered. When Manager Williamson began he feared that he could not get sixty, the required number to secure the putting in of a plant. But now that it is started, the prospects are good for 125 telephones by the time the exchange is opened.

A new company has been organized at Fort Collins, Col., known as the Fort Collins Electric company, and has purchased the electric plant of the Fort Collins Light, Heat & Power company. The new company has a capital stock of $50,000. William B. Miner is president, William B. Stewart vice-president, and Frank J. Annis secretary and treasurer. The system of lights will be extended to all the principal residence streets in the city. K.

THE ELECTRIC LIGHT.

The work of wiring the Auditorium building, Chicago, is progressing rapidly, and the electric lighting system will soon be completed.

The Elyton Land company is introducing on the Highland avenue dummy line, at Birmingham, Ala., its Bernstein series incandescent lamps of 50 candle power, to be run from a Brush machine.

A dispatch from Fergus Falls, Minn., says: A consolidation has been effected between the Fergus Falls Gas company and the Fergus Falls Electric Light company. The electric light plant will be moved to a building near the gas house.

The city council of Philadelphia has under consideration a recommendation of the finance committee to apply $25,000 of the surplus to the extension of electric lights. It is also proposed to apply $10,000 to the extension of the police and fire telegraph, and $10,000 to the police patrol system.

The annual report of the warden of the Southern Indiana penitentiary, at Jeffersonville, Ind , presented last week, stated that the gas lights used at the institution during the year cost $1,650.40 The board of directors considers this too much, and is debating the feasibility of putting in a system of electric lights.

The Knoxville, Tenn., Electric Light company is pushing its works rapidly, the machinery in its new building is in position, poles have been erected and wires strung throughout the town, and incandescent fixtures placed in the principal residences. The outlook for the success of the company is excellent.

The Thomson-Houston Electric company reports the following among its recent sales: Richmond, Mo., arc plant, 35 lights; Lansing, Mich , Gas company, incandescent plant, 500 lights, alternating system; Cantine & Co., Crestline, O., 200 incandescent lights; Belding Manufacturing company, Belding, Mich., incandescent plant, 200 lights, for use in worksbops.

Among the recent sales of the Indianapolis Jenney Electric company are the following: Thirty arc-light outfit to the Coshocton, O., Gas & Electric Light company, increase of plant; three 500-light incandescent machines to the Hauss Electric Lighting company, Cincinnati, for central station lighting; 500-light incandescent outfit for the Park Theater, Indianapolis; complete electrical outfit, 500 incandescent and fifty arcs, to the North Topeka Electric Light company.

W. B. Dye, president of the council of Albion, N. Y., says: "There is no electric company being formed in this village that I am aware of, though there is a report current to the contrary. We have received a proposition from two different electric light companies to light the place, which we are now considering, one from the Thomson-Houston company of New York, and the other from the Fort Wayne Jenney company of Fort Wayne, Ind."

The California street Cable Car company of San Francisco has provided its engine and car house with an incandescent electric light plant. The illumination is a marked improvement the old system of part gas and part oil. It is understood that experiments are being made by the company to test the feasibility of a traveling electric lamp, which may be moved from point to point along the road, as occasion may require. Such a device would prove of great assistance in making repairs at night, and in other emergencies.

The introduction of incandescent lights in places formerly occupied by gas or oil fixtures, has led to many funny incidents. Many cases of young men attempting to ignite paper from a globe to obtain a light for a cigar have been reported. At a prominent resort in Chicago a figure holding a lamp from which patrons received a light was considered a time-honored landmark. Recently, however, an incandescent lamp has been placed where the gas jet formerly flickered, and many a patron labors in vain endeavoring to get a light for his cigar from the globe.

The Sheffield (Ala) *Enterprise* says: "A. R. Roe, the electrician of the Sheffield Electric Light works, is evidently determined to make the most of the opportunities presented for the use of the light, whenever his own convenience can be served and the utility of the light be shown. By the use of a small storage battery carried under the seat of his buggy he supplies a 5-candle power light, which is so placed on the horse's head as to throw a strong light on the road ahead of him and make him on the darkest of nights independent of street lights. It is a simple arrangement, easily applied, and much more convenient than a lantern, and will yet come into general use."

The Reno, Nev., Electric Light company, which was organized mainly by San Francisco capitalists and incorporated October 23, 1886, is now controlled by local capitalists, and is extending its operations. When the works were first started they had a capacity of 45 lamps, but only 20 were utilized. The system, however, gradually grew in favor until the full power was demanded, and foreseeing the necessity of still greater capacity, the plant was increased in power until it now possesses a capacity of 95 lamps, all of which are utilized. There are also many demands for additional light, and the company is considering the advisability of introducing a 600 incandescent light plant.

It would seem to be difficult to evolve a perfectly new and original system of public lighting by electricity, but it has been done—this time by a Frenchman, says the London *Electrical Engineer*. M. G. A. Tabourin has written to the municipal council of Paris, offering to light Paris upon his system, which will do away with underground mains, and permit the rapid extension of electric light throughout Paris without interfering with the gas companies. In this most wondrous proposal each gas lamp is to be furnished at its base with a small rotary gas engine, ten inches in diameter, with a small dynamo; and these small installations are to supply arc lamps on the top of the lamp-post, thus burning gas at the bottom and producing electric light at the top of each post. The inventor offers to run at his own cost for several days, opposite the Theatre Francais, one of these electric lights on his new system. It is just possible there may be some practical use for such a comb nation for production of single arc lamps for photographers, etc., by the consumption of gas, but even if there proves to be anything in the small rotary gas engine we should imagine the offer to fit up the public lamps of Paris in this manner is a good deal of the nature of a bold advertisement.

Electric lighting is progressing rapidly in Berlin. A correspondent writes: "In addition to the two new central stations projected for Berlin, and on which I have already reported, there will be erected a third station, bringing up the total capacity of electric lighting plant to 18,000 horse power, capable of supplying 200,000 lamps, which is about one-quarter of the total number of gas burners fixed in Berlin. The present capacity of the two existing stations is 3,800 horse power. In the future it is proposed to use for central station lighting steam engines of 1,000 horse power instead of the present unit of 300 horse power in order to reduce the proportional cost of attendance. All the manufacturers of glow lamps are busy, and are hardly able to fill the orders they have received for the present season. In many cases works are being enlarged, and the company making the Seel lamp are not only extending their manufactory to three times its present size, but also projecting the erection of branch factories in Germany and abroad. A demand has lately arisen for lamps of high voltage, and several manufacturers have already made experimental lamps for 150 and 200 volts, some of which I have tested. In no case was the lamp found good enough for practical use. The general defect of all these lamps is that the thin filament is either broken from purely mechanical causes, or when heated by the current, bends and touches the glass, with the result of causing the latter to crack."

A dispatch from New York says: Forty millions of dollars is a big sum to put into a single enterprise, but it looks as if it would be done if the electric light syndicate succeeds. Henry Villard has been a stockholder in the Edison Electric Light company for a dozen years. He was a director until his departure for Europe, and will go into the directory again at the next election. Since his return from Germany Villard appears to have unlimited capital. Within the past few months he has gone into the market, bought up all the floating stock of the concern and secured several blocks by private purchase. The price advanced under this bull movement. It was a very big deal to obtain controlling interest in the Edison Electric Light company, which has a capital of $1,000,000, but Villard and his friends have done this, and now own a majority of the stock This is only a stepping stone to a gigantic combination of electric systems to control the business of electric lighting in the United States. The scheme comprehends, first, control of the Edison system, parent and branch companies scattered throughout the United States; second, consolidation of the leading opposition organizations using incandescent light, or the distribution of electricity for light and power. The Edison system has licensed 150 central stations in the United States, with an aggregate capital of $30,000,000. The Pennsylvania Electric company, its chief competitor, has established 132 central stations, with a capital of about $10,000,000. It would therefore require upward of $40,000,000 to control and consolidate these two systems. The Villard syndicate, having already gobbled the Edison company in this city, is now turning its attention to securing stock in local organizations in 150 cities where works are already in operation. A large number have been brought in, and other deals are getting along nicely for the originators. It is said Villard has been promised more money than he can possibly use. Capitalists in Berlin and Frankfort have been tumbling over each other for the past three months, so great is their desire to get in.

THE TELEPHONE.

Direct communication between Boston and Buffalo, a distance of 810 miles, has been accomplished successfully by telephone.

Telephone communication is to be established this winter between the thirty or more Life Saving Service stations of the south coast of Long Island, says the New York *Sun*. Upward of a hundred miles will then be connected by wire, so insuring much prompter and surer summoning of help from one station to another than by the old signaling system, which is less rapid, and finds obstacles to its use in bad weather, when help may be most urgently needed. Congress was justified in making the appropriation for this purpose, since the stations of the entire New Jersey coast from New York harbor to Delaware Bay have already been connected by telephone, and now not only can help be obtained there more promptly, but patrolling duties are aided. Probably the Carolina and other coasts will be connected in the same way, and we may in time have a complete telephonic line of communication along the Atlantic seaboard, which may some day find other uses besides the humane ones primarily designed. Congress will make no mistake in promptly securing for the Life Saving service the best appliances and aids for its valuable work. The annual record of lives and property preserved from destruction forms the best claim of this organization to favorable consideration.

THE ELECTRIC MOTOR.

Detroit will probably have an electrical railway at an early day.

The Detroit *News* says the Woodward Electrical company has received an order to construct a car equipped with the Detroit storage batteries, to be tested on the Fourth avenue line in New York city.

Memphis, Tenn., is preparing for the introduction of an electrical street railway. A company has been formed, the right of way secured over several streets, and negotiations are now pending for the purchase of the plant of the Prospect park dummy line.

The board of improvements of Cleveland has granted the South Side Electrical railway franchise, and the establishment of the line will be begun immediately. The cause of the delay was a dispute over the route of the proposed railway, property owners of several streets desiring to secure it.

A good story is told of one of the men who has charge of an electric car at Lynn, Mass. The car was going down a steep grade when a young lady signalled. It was stopped, but before the conductor had given the signal to go ahead it commenced to move and the man at the crank vigorously plied the brakes and cried "whoa" at the same time.

Another application of electromotive force to mining purposes on a large scale is in contemplation. The Humboldt Electric Power & Mining company has been formed in London to purchase mining claims from the Consolidated Esmeralda company in the Durand Hill district, Aurora county, Nevada, and it is proposed to transmit 200-horse power by electricity from a water power motor.

The decision in the case of the application of the Rochester, N. Y., Electric Railway company to acquire lands of the Rome, Watertown & Ogdensburg Railway company and the Charlotte Iron works was favorable to the petitioners, and condemnation proceedings will be instituted immediately. This removes the last obstacle, and it is quite probable that the railway will be opened early in the spring.

The Thomson-Houston company's electric railway at Omaha and Council Bluffs continues to operate to the satisfaction of residents. The daily receipts of each train of two cars are reported to be $40 per day. This road is regarded as one of the most interesting in operation, and is visited by dozens of strangers every day. The stockholders of the company are thoroughly satisfied with the operation of the road and the electrical appliances.

A Toulon correspondent, writing about the preliminary trials of the new French electrical submarine vessel, the Gymnote, says: The object of these trials was to satisfy the designer of the vessel, a retired director of naval construction, M. Zédé, that his anticipations were correct. The vessel becomes submerged like a fish, and can be easily kept at any wished-for depth; it can attain a speed of nine to ten knots: the lighting is excellent, respiration easy, and, in a word, the boat is a great success. Though the normal crew is only three men, there were five on board during these experiments: M. Zédé, M. Krebs, of the engineers, who designed and constructed the whole of the electrical portion; M. Romazzotti, the naval engineer who built the Gymnote, and who introduced numerous improvements in the interior installations; Lieutenant Baudry de Lacantinerie, who is to be the commander of the Gymnote, and head boatswain Picon, who had been in charge during the construction of the boat at Mourillon. Before being placed with the fleet there are a few inconsiderable interior alterations to be made, such as perfecting in a few points the insulation of the accumulators, which will take about a month, when the Gymnote will be ready for service.

The following statement has been received from the Electrical Accumulator company of New York: "The *Electrical World* of December 22d contains a statement from the Julien company, by which it is made to appear that the application of the Electrical Accumulator company for a certain patent has been refused by the United States patent office. Such a statement is not true; on the contrary, the commissioner of patents, Washington, has just rendered a decision sustaining the claims of John S. Sellon as the inventor of an inoxidizable alloy support plate, and Mr. Sellon's patent has been passed to issue, and will shortly appear on the patent records duly assigned to the Electrical Accumulator company. The application of Sellon was founded upon the specification of his English patent No. 3,987, dated Sept. 15, 1881. This British patent of Sellon's is the first publication to describe the use of a plate of lead and antimony, or an alloy of two metals, either with or without the use and application of an amalgam as a support for the active material in a battery of the Faure type. The issue of this patent in the United States will enable the assignee of Sellon, the Electrical Accumulator company, to control the manufacture, use and sale of secondary batteries employing lead and antimony in the composition of support plates, whether mercury to form an amalgam be present or not, and suits will be instituted in the courts for the recovery of damages at once."

A London paper says: "The Ward electric omnibus is often to be seen on its peregrinations in the early or late hours. It is said to be the only one in the world actually at present able to run on the ordinary streets without rails, and taking its place among other vehicles drawn by horses. The electric omnibus said to be running in Paris turns out to be a tramcar, and not a true omnibus. The Ward electric omnibus, however, is meant to take its place without preparation of the roads, and has now been tried on all sorts of road to be met with on London streets—macadam, paved, asphalt, wood blocks, etc.—and has been successfully run upon the most difficult up and down hill grades on which vans are run in London." The London *Electrician* says of the vehicle: "Until we have taken an opportunity to inspect Mr. Radcliffe Ward's 'electric omnibus' we do not care to express a definite opinion upon its merits. It may be a feasible idea so long as it is only proposed to run on asphalt roads without serious gradients. But what will the authorities say? Will not the red flag clause come in? Anyhow, we think it is a great deal too bad of the daily papers to insert such solemn foolery on the subject as has been going the rounds this week. After recounting in great detail the route taken in a trial run, the newspapers assure us that 'This is the only electrical omnibus in the world *capable of steering to right and left*.' They omit, however, to state that it is also capable of standing still, of turning round, and even of running backward! Truly this is a marvelous age!"

THE TELEGRAPH.

The Allegheny Arch Telegraph company has been granted a charter. The company proposes to construct arches over the principal streets of Pittsburgh on which to string wires.

A dispatch from Winnipeg says: Professor Grant, principal of Queen's college, Kingston, has just returned from a visit to Australia in connection with the proposed cable between Victoria, British Columbia, and Sydney, Australia. He is hopeful of success, although he contemplates serious opposition from the managers of the present cable, who will, he says, put all possible obstacles in the way of the project. Professor Grant maintains that the present cable does answer the requirements of business. He says it lies over the volcanic sea bed of the China Sea, and that, although there is a duplicate cable, both cables have been repeatedly broken and Australia thus isolated from the outside world. As to the success of the proposed new cable the professor says there can be no doubt. The Melbourne and Sydney people alone will insist upon it, and the co-operation of the two Australian goverments is confidently expected.

Miscellaneous Notes.

An error was made in the introduction of Dr. Whitefield's paper before the Chicago Electric club, printed in last week's issue. The opening sentence should have been as follows: "The point last stated I will speak of after giving a theory of dental caries that has, so far as I know of, no single fact to controvert it." In the latter part of the paper, where reference was made to chemical changes, "chlorine in its nascent state" should have appeared instead of "parent state."

The board of aldermen of Boston recently passed an order over the mayor's veto, directing the superintendent of streets to give permits to open certain streets to Henry E. Cobb, Royal M. Pulsifer and Francis R. Chapman, who had previously been granted over the mayor's veto the exclusive privilege for twenty years to construct and maintain conduits and pipes in which to conduct wires for telegraph, telephone or other electric wires. The board also passed over the mayor's veto an order approving the carbonized stone conduit and drawing-in system, with manholes at frequent intervals, although the corporation counsel is on record in two communications to the city government declaring the grant illegal. The electric light, telephone and telegraph companies have united in opposition to the orders. The electric light and telegraph companies are opposed to placing their wires underground mainly on account of the expense, it is said, while the telephone company is anxious to secure a franchine for itself to lay its own conduits.

The police commissioners of Rochester, N. Y., are considering the advisability of introducing a new police patrol system in that city. The Gamewell company put in a plant at its own expense a few years ago, which is considered one of the finest in the country. The system proved satisfactory, the city accepted the plant after thoroughly testing it, and the benefits derived from it were so manifest that it was deemed advisable to enlarge the system and double the number of boxes. The police commissioners claim, however, that the Gamewell company demanded too much for the additional boxes, and correspondence was opened with other companies. The board is now considering the purchase of a new system, if one equally practicable can be introduced. The question of operating another system in connection with the Gamewell was also considered. The Municipal patrol system of Boston and the Louisville system are now under consideration, and these companies are making strong bids for the plant. The Gamewell company, however, is confident of success.

The Edison talking newspaper is the latest device proposed in the phonograph line. It is said that 20,000 or more copies of the same cylinder could be turned out in one hour. They can be adjusted to any phonograph, so that 20,000 or more "talking machines" can repeat the same sentence at a given moment. The possibility of this was suggested to the inventor for the benefit of those who wished to keep abreast of the news of the day, but who from failing eyesight or from other causes are not able to read newspapers. The Edison Talking Newspaper company, it is said, will supply the phonographs at an annual rental, and they can be used the same as others to reproduce singing, piano-playing, whistling, band music and elocution, but they will be especially designed for correspondence. Phonograms later will contain each day all the latest news in condensed form and will cover each subdivision, such as cable and telegraphic, political, dramatic, commercial, monetary, etc. Each phonograph will be plainly marked so that the reader, or rather hearer, can choose for himself which one he cares to use first.

Captain Zalinski of the United States army, who has become famous for the invention of the dynamite gun, says that the most wonderful thing about Keely or his so-called motor is that he has for fifteen years been able to gull so many people, and among them many prominent men. Zalinski says Keely always has been a fraud, and that his first exhibition at Sandy Hook, where a gun was tested, proved him such. Zalinski says he then offered to expose Keely, but the latter would not let him have access to the gun to illustrate his statements. Later Zalinski attended experiments at Keely's laboratory at Philadelphia, and he says these partook of legerdemain. Here Keely gave an exhibition of his alleged instantaneous generation of pressure, claiming he had 54,000 pounds of pressure. Zalinski produced a 10,000 pound pressure gauge and offered it to Keely, saying he would like to see it broken. To this Keely said he did not believe much in gauge measurements. Zalinski thus characterizes Keely and his claims: "In my opinion, this man is a perfect charlatan. He claims to use an ethereal force, evolving something out of nothing, which we, with our present knowledge of mechanics, know to be impossible. If Mr. Keely's invention had been anything at all, it would have been put to practical use long ago. If one-tenth of what he claims was true, his machine would be the most valuable in the world. With it the cost of running engines, railroad trains or steamboats would be comparatively nothing aside from the cost of the machine. Mr. Keely is now in a very unpleasant position. He must reveal his great 'secret,' or he must stand the wrath of his deluded stockholders."

Personal Paragraphs.

F. M. Bishop, manager of the telepone exchange, Athens, Ga., died recently at Atlanta, Ga., of typhoid fever.

General Manager Pratt, of the Jarvis Engineering company, Boston, has been making a business trip through the west, and favored this office with a call last week.

O. C. Steele, the Brush company's western agent, with headquarters at Kansas City, on account of ill health, will temporarily retire from the electric lighting business January 1st.

Business Mention.

Edward P. Allis & Co. of Milwaukee have issued an unusually handsome calendar for 1889.

Among the recent sales of the Electrical Accumulator company is one of two hundred and one 15-A cells to the Inter State Electric company of Kansas City.

The Electrical Supply company of Chicago have arranged to carry a full line of Sawyer-Man incandescent electric lamps. They have also recently received a large consignment of Ayrton & Perry's ammeters and voltmeters.

Electrical Patents.

Issued December 16, 1888.

394,555. Annunciator. William C. Clark, Portland, Me

394,563. Temperature Regulator. Lucian F. Easton, La Crosse, Wis.

394,568. Switch or Circuit-Changer. William W. Griscom, Haverford College, Philadelphia, Pa.

394,613. Separating Partition for Galvanic Batteries. Isaiah L. Roberts, Brooklyn, N. Y.

The second claim follows: "A separating partition or diaphragm for an electric battery, consisting of earthenware having its pores closed with gelatinized silicate of soda or potash."

394,614. Separating Diaphragm for Galvanic Batteries. Isaiah L. Roberts and Henry L. Brevoort, New York, N. Y.

The second claim is appended: "3. As a new article of manufacture, a cup, partition or diaphragm, for use in an electric battery or electrolytic bath, composed of textile or fibrous materials impregnated with a gelatinous material."

394,615. Treating Diaphragms and Cups for use in Electric Batteries. Isaiah L. Roberts, Brooklyn, N Y.

Claim 1: "The process of treating porous cups, diaphragms or partitions, which consists in closing their pores with a substance which can be gelatinized, gelatinizing the substance in and on the holder, and treating the same with a deliquescent salt."

394,616. Diaphragm for Galvanic Batteries. Isaiah L. Roberts, Brooklyn, N. Y.

Claim 1: "A separating partition or diaphragm for an electric battery, composed partially or wholly of a gelatinous or jelly-like substance made of insoluble saponified material."

344,617. Diaphragm for Galvanic Batteries. Isaiah L. Roberts and Henry L. Brevoort, Brooklyn, N. Y.

Claim 1: "A diaphragm or partition for an electric battery, partially or wholly of a gelatinous or jelly-like substance obtained from albuminous materials."

394,621. Electric Tramway. Michael H. Smith, Halifax, County of York, England.

394,627. Electric Brake System. Watson P. Widdifield, Uxbridge, Ontario, Canada, and Alexander H. Bowman, Packerton, Pa.

394,638. Separating Partition for Galvanic Batteries. Henry L. Brevoort and Isaiah L. Roberts, Brooklyn, N. Y.

Claim 2: "A separating partition or diaphragm for an electric battery, having its pores closed by gelatinous material."

394,642. Distribution of Electricity by Secondary Batteries. Thomas P. Conant, New York, N. Y.

The improvement consists in dividing the working circuit into two sections, one to be supplied by the battery, the other by the dynamo when operating to supplement the battery. In the working circuit is placed an automatic switch, operated by an adjustable electro-magnet which is located in circuit between the dynamo and battery. When the proper current is flowing from the dynamo the switch is closed and the section of the working circuit to be fed by the dynamos, connected; but the moment such current from the dynamo fails the said switch opens and the dynamo section of the working circuit is disconnected, thus avoiding injury to the battery.

394,648. Conduit for Electric or Cable Railways. Thaddeus W. Harris, New York, N. Y.

364,670. Galvanic Battery Robert D. Wright, Kirkwood, Mo.

394,680. Support for Incandescent Electric Lights. Alfred Dawes, Chelsea, Mass.

394,697. Telegraphy. Percy F. Jamieson, Batavia, Ohio.

394,728. Indicator for Electric Circuits Oliver B. Shallenberger, Rochester, Pa.

394,734. Driving Gear for Electro Magnetically Propelled Vehicles. William L. Stevens, Boston, Mass.

394,735. Electro-Magnetically Propelled Vehicle. William L. Stevens, Boston, Mass.

394,784. Electric Signaling Apparatus. George F. Milliken, Boston, Mass.

394,791. Electric Arc Lamp. Rupert Shefbauer, Dresden, Saxony, Germany.

394,797. Collector. John Tregoning, Lynn, Mass.

394,807. Electro-Therapeutic Tool-Holder. Allan H. Bacon, Webster Groves, Mo.

394,810. Carbon Electrode for Electric Batteries. John Beattie, jr., Fall River, Mass.

Claim: "Blocks, plates or rods to be used for electric battery purposes, consisting of carbonized salt-hay or sedge-grass, pulverized and molded into shape with the aid of any kind of adhesive material."

394,818. Dynamo Electric Machinery. Charles S. Bradley, Yonkers, N. Y.

Claim 2 follows: "2. An armature composed of an iron core having longitudinal peripheral grooves, insulated conductors laid in said grooves, and end connections joining said conductors in pairs in rectangles, in combination with a multipolar field magnet system presenting opposite polarities to the respective sides of each such rectangles."

394,819. Dynamo Electric Machinery. Charles S. Bradley, Yonkers, N. Y.

394,832. Telephone System. John F. Casey, St. Louis, Mo.

The invention consists, briefly, in an extended call circuit between central offices, which extended call circuit is provided with one or more operators' outfits, and also in providing the switch-boards at said central offices with a trunking section, or devices and means whereby trunking connections can be quickly made at each office.

394,833. Telephone Exchange System. John F. Casey, St. Louis, Mo.

The object of the invention is to provide means whereby subscribers may call up the central office even though the call circuit be broken or grounded between the subscriber and said central office.

Claim 5 is appended: "The combination, with a call circuit and a talking circuit, of an electrical connection normally intact between the two, whereby when the calling circuit becomes grounded the talking circuit can be used to transmit the calls sent over the calling circuit."

394,837. Conveying Electric Energy. Sebastian Ziani de Ferranti, Hampstead, County of Middlesex, England.

Claim 1: "The combination, with insulated supports arranged in pairs, of a conductor divided into comparatively short lengths and having adjoining ends of lengths secured to adjoining supports, and removable electrical connections between the two supports by which the ends of the conductor are electrically connected."

394,838. Conveying Electric Energy. Sebastian Ziani de Ferranti, Hampstead, County of Middlesex, England.

394,839. Magneto Generator for Fire Alarm Circuits. William L. Denio, Rochester, N. Y.

We give the last clause: "9. The combination, with a magneto generator embodying a field magnet, a movable armature, and a motor for operating it, of a readily fusible connection for preventing said armature from moving until melted, and then allowing the motor to move it and generate a current, a circuit embodying the coils of the generator, and a shunt controlled by the fusible connection."

394,880. Electric Meter. Anthony Reckenzaun and James A. Pentz, Philadelphia, Pa.

394,881. Electric Meter. Anthony Reckenzaun, Philadelphia, Pa.

The invention has for its objects to periodically release contact between parts of the variable speed gear employed to move the registering devices, so that said parts may assume the position they should have relatively to the energy consumed.

It further has for its object to compensate for the varying attractive force of a solenoid on an iron core, which, as is well known, is not always in exact proportion to the strength of the current employed.

394,883. Dynamo Electric Machine. George W. Riethmann, Denver, Col.

394,887. Electric Locomotive. Sidney H. Short, Denver, Col.

394,892 Portable Electric Welding Apparatus. Eilhu Thomson, Lynn, Mass.

394,897. Connector for Secondary Batteries. Henry H. Wiegand, Baltimore, Md.

394,905. Armature Core for Dynamo Electric Machinery. Warren S. Belding, Chicago, Ill.

394,414. Telephone Exchange System. George F. Durant, St. Louis, Mo., and Henry L. Bailey, Brooklyn, N. Y.

The object of the invention is to diminish the ringing induction in telephone lines, and also to indicate to the operator at the central office that the lines are busy, or that a line is connected with another line, or to indicate that the subscriber has failed to replace the telephone on his hook.

394,925. Electric Push Button. Andrew J. Hoyt, Philadelphia, Pa.

394,946. Electric Circuit. John B. Wood, Montreal, Quebec, Canada.

The invention has reference to certain improvements in the circuits used in telephoning and telegraphing, by which, without the use of a central office, electrical connections may be made between any two stations connected therewith—that is to say, in the same circuit—and disconnected at will without calling any other station or location than the one desired.

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HOUSE OF REPRESENTATIVES, U. S.

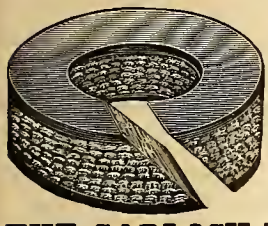
WASHINGTON, D. C., December 20, 1888.

Sealed proposals will be received until 12 o'clock, M. on Thursday, January 10, 1889, for supplying and installing an Electric Light Plant and fixtures, or either, and Electric Bells for the House Wing, Rotunda, Dome and Tholus of the Capitol at Washington, in accordance with plans and specifications to be furnished by the clerk of this Committee upon application therefor by intended bidders.

The right to reject all bids is reserved. Applications for plans and specifications, and for any further information must be made to "John Dougherty, Clerk of the Committee on Public Buildings and Grounds, House of Representatives, Washington, D. C.," with whom the sealed proposals must be filed.

By order of the Committee. SAMUEL DIBBLE, Chairman.
JOHN DOUGHERTY, Clerk.

GARLOCK'S RING PACKINGS



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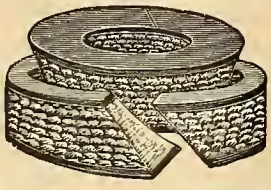

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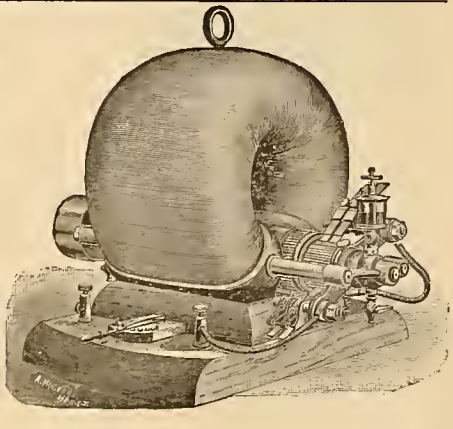

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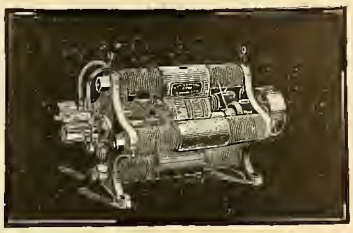

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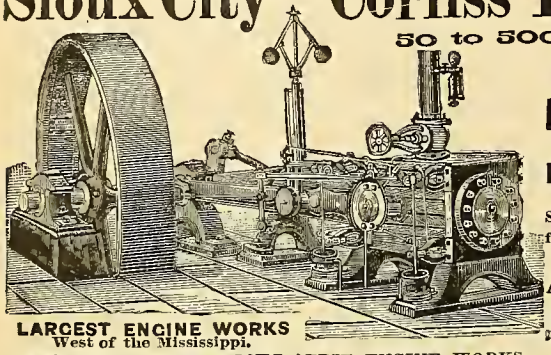

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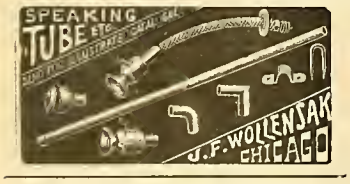

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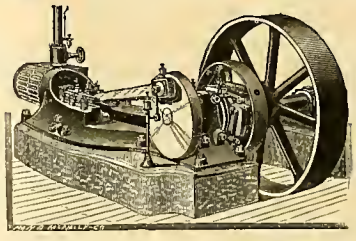

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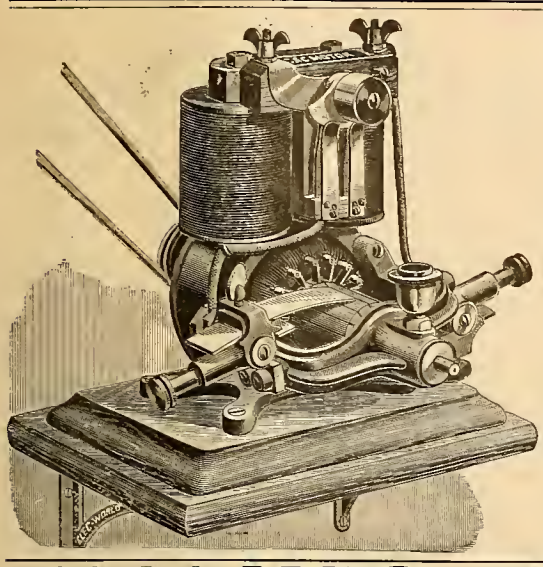

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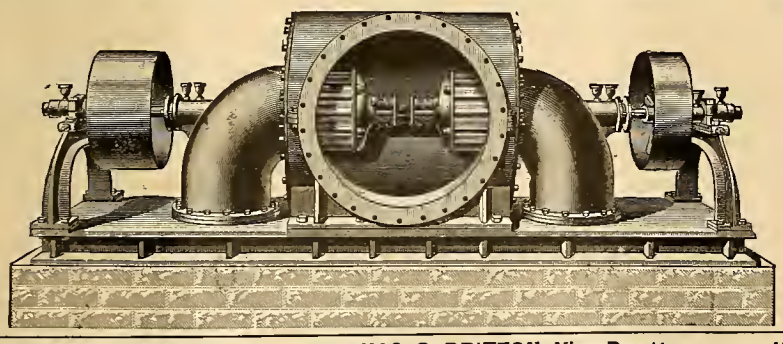

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TOTAL, 86 ENGINES, AGGREGATING 3310 H. P.

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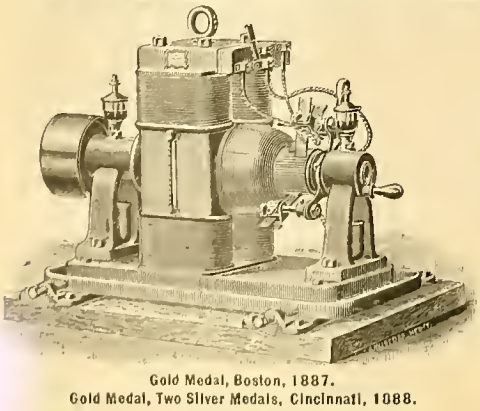

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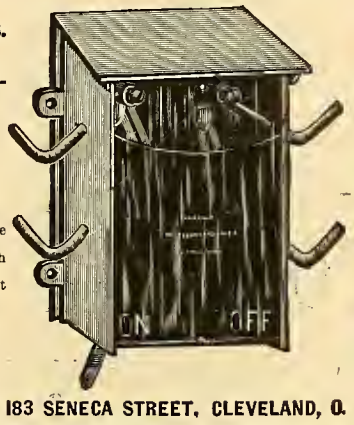

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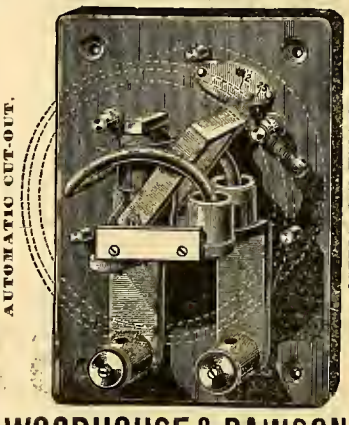

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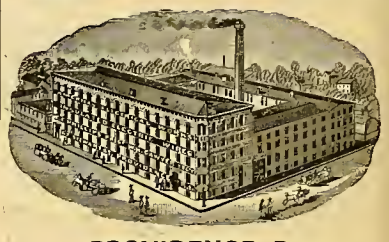

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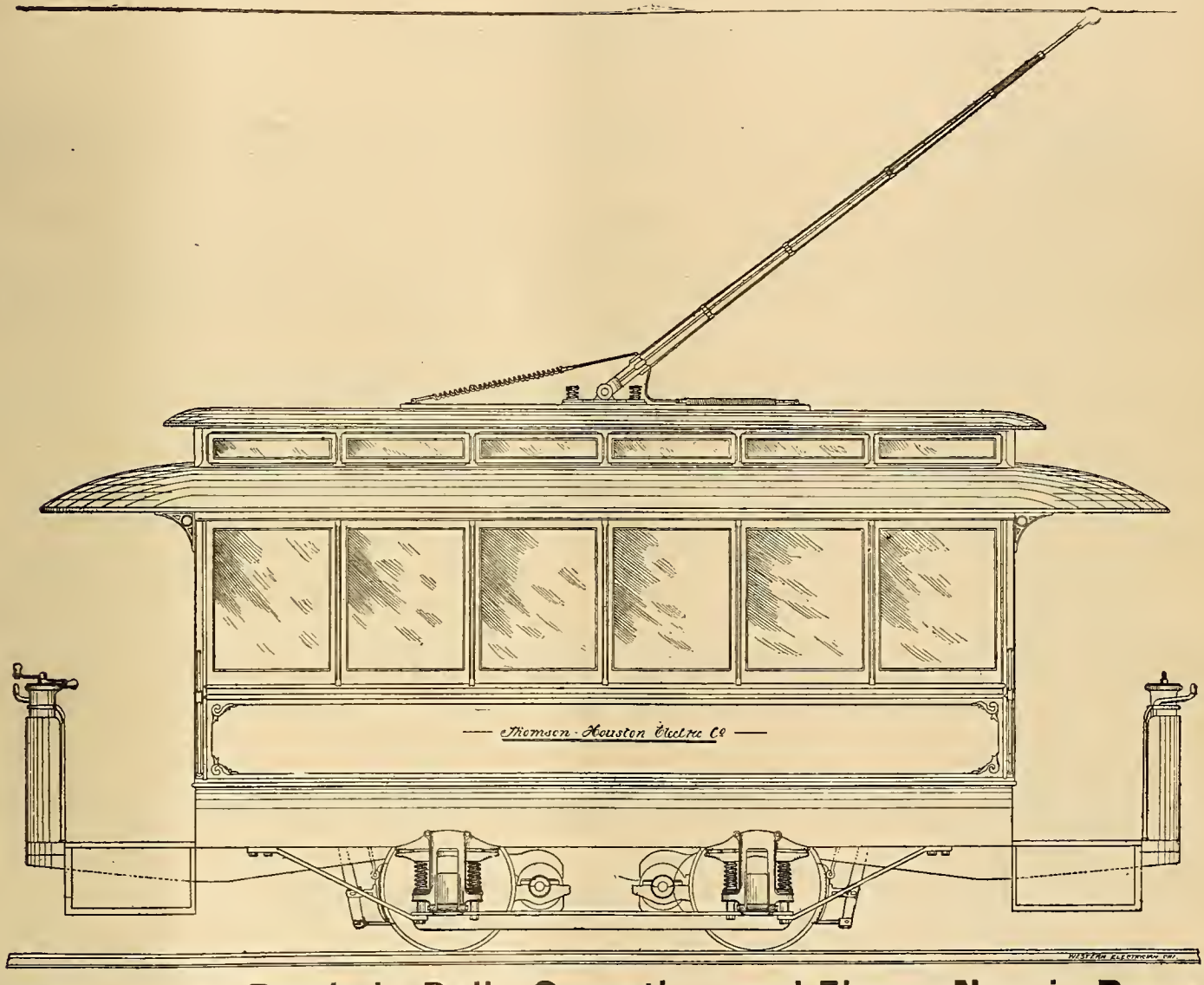

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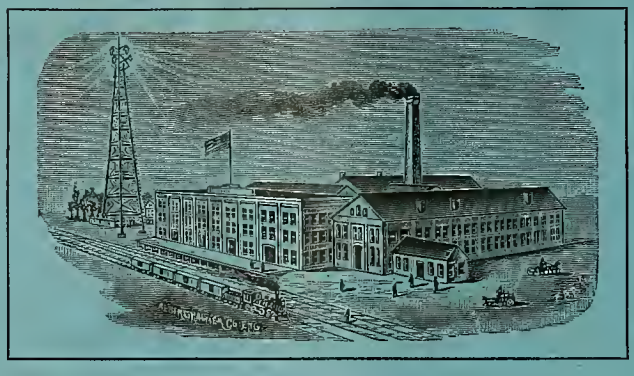

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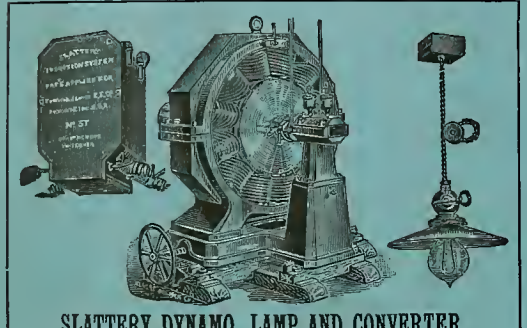

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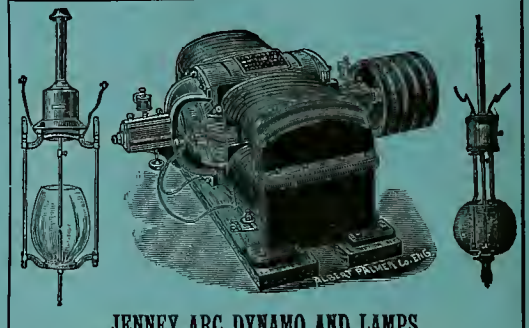

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